Hill-Rom Air-Shields®
A HILLENBRAND INDUSTRY

INSTRUCTIONS	REASON FOR CHANGE
INSERT THIS SHEET INTO THE MANUAL DESCRIBED BELOW.	LOW PRESSURE GAS MODULE

EQUIPMENT: **Resuscitaire Radiant Warmer, Model RW82**

MANUAL TITLE: **Service Manual**

MANUAL CAT. NO.: ***82 990 07***

ADDENDUM INFORMATION

MAKE THE FOLLOWING CHANGES WHEN A LOW PRESSURE GAS MODULE IS PRESENT IN THE RESUSCITAIRE RADIANT WARMER:

TABLE 3.1A SPECIFICATIONS Page 3-3:

Change cylinder pressure from 2900 psi max (199.8 bar) to 3000 psi max (207 bar)

TABLE 3.1b SPECIFICATIONS Page 3-5:

Change cylinder pressure from 199.8 bar to 207 bar.

SECTION 3 RESERVE GAS SUPPLY PAGE 3-18. ADD THE FOWLING STATEMENT:

The regulator for United Kingdom and Canadian units is preset to 45 psi when the cylinder pressure is 1500 psi.

TABLE 6.10 RESUSCITAIRE RADIANT WARMER O_2 PIPELINE (DISS/NIST) WITH O_2 CYLINDER (PIN-INDEX) GAS SUPPLY ASSEMBLY, PARTS LIST ADDS THE FOLLOWING:

Gas Supply, O_2 Pipeline (NIST) O_2 with Cylinder (Pin-Index) Low Pressure - Part Number 81 501 94.

Add to Item 23 regulator, 45 psi W/press relief - Part number 81 501 77.

TABLE 6.12 RESUSCITAIRE RADIANT WARMER O_2/AIR PIPELINE (DISS/NIST) WITH O_2/AIR CYLINDER (PIN-INDEX) GAS SUPPLY ASSEMBLY, PARTS LIST ADDS THE FOLLOWING:

Gas Supply, O_2/Air Pipeline (NIST) with Cylinder (Pin-Index) Low Pressure - Part Number 81 501 95.

Add to Item 23 regulator, 45 psi W/press relief - Part number 81 501 77.

Hill-Rom Air-Shields®

A HILLENBRAND INDUSTRY

INSTRUCTIONS

INSERT THIS SHEET INTO THE MANUAL DESCRIBED BELOW.

REASON FOR CHANGE

SERVICE INSTRUCTIONS GAS DELIVERY MODULE

EQUIPMENT: **Resuscitaire© Radiant Warmer**

MANUAL TITLE: **Service Manual**

MANUAL CAT. NO.: **82 990 07 - 7 (man221ra)**

ADDENDUM INFORMATION

SPECIFICATIONS

Resuscitation wall supply pressure ..... 2.8 bar (40 psi) to 5.2 bar (75 psi)

Resuscitation cylinder pressure ..... 199.8 bar (2900 psi) maximum

Resuscitation suction circuit adjustable

suction intensity ..... 0 mm hg 0" H_2O to 150 Hg (80" H_2O)

Resuscitation Primary Outlet supply pressure limit ..... 15.7 kPa (160 cm H_2O) -/+ 20%

Resuscitation Primary Outlet flow range ..... 0 to 15 lpm

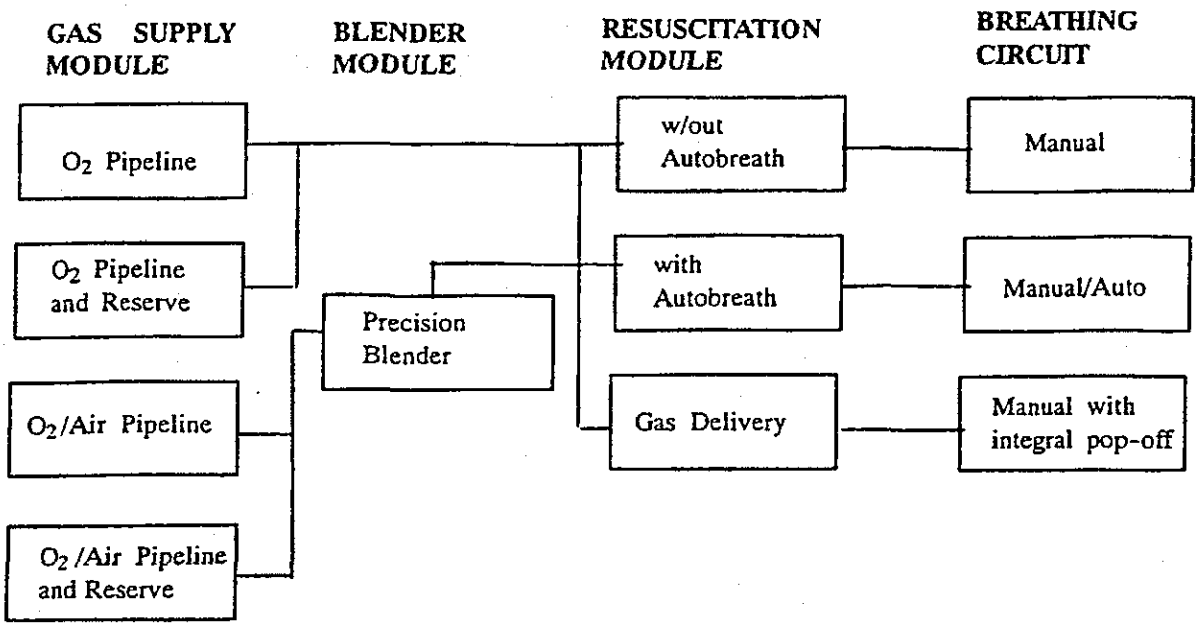
Resuscitation Auxiliary Outlet pressure limit ..... 16 kPa (160 cm H_2O) -/+ 10%

Resuscitation Auxiliary Outlet flow range ..... 0 to 15 lpm

PNEUMATIC SCHEMATIC

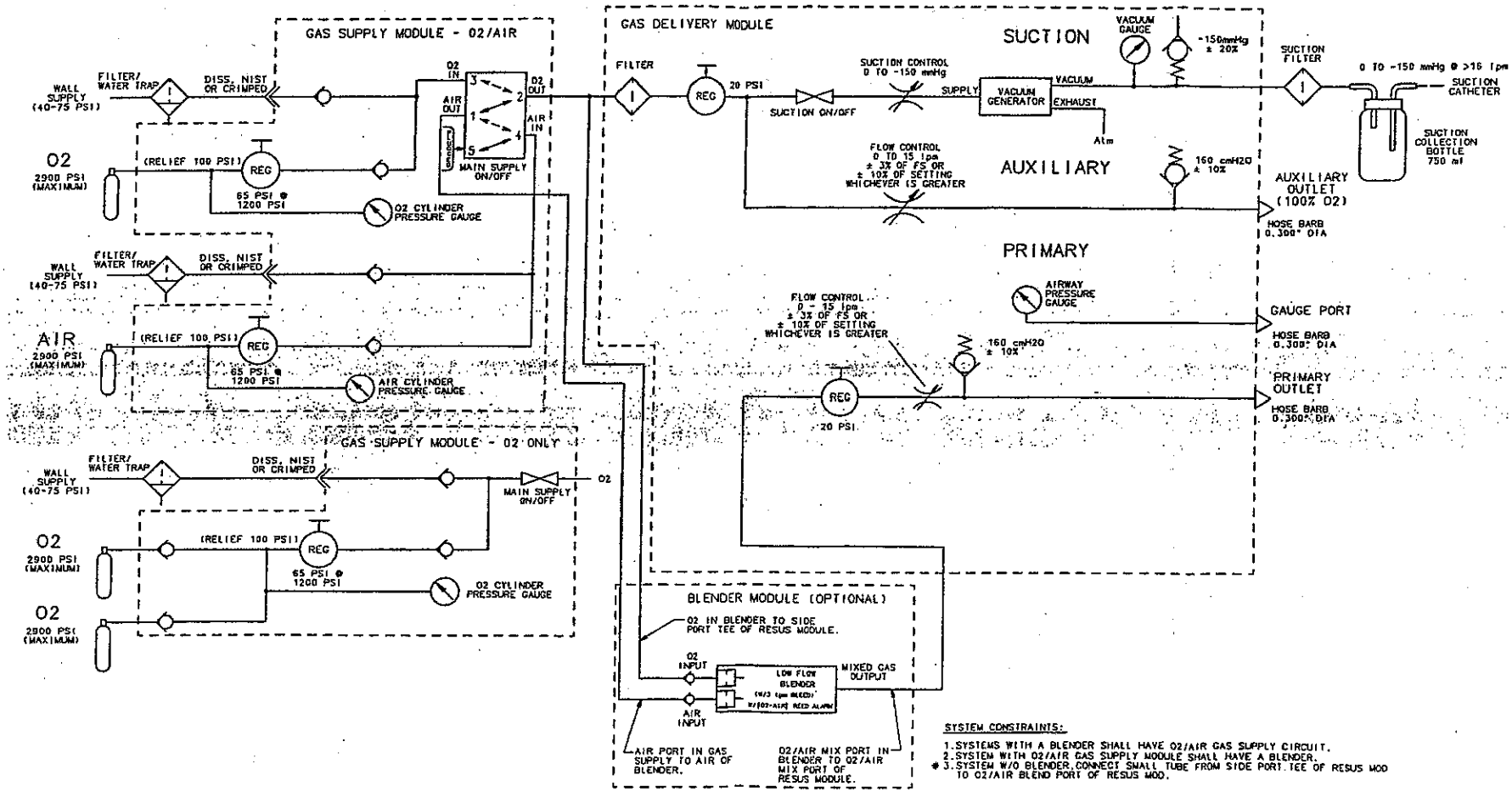
The Pneumatic Schematic for the Gas Delivery Module is attached.

THEORY OF OPERATION



FUNCTIONAL BLOCK DIAGRAM

When the blender module is included in the system, the Gas delivery Module provides 0 to 15 lpm of O_2/Air mixture as selected by the user. when no blender module is included in the system, the Gas Delivery Module provides 0 to 15 lpm of O_2 as selected by the user. The flow control is calibrated dial type flow adjustment.


GAS SUPPLY MODULE - 02/AIR
GAS DELIVERY MODULE
SUCTION
PRIMARY
AUXILIARY
WALL SUPPLY (40-75 PSI)
FILTER/ WATER TRAP
DISS. NIST OR CRIMPED
02 2900 PSI (MAXIMUM)
AIR 2900 PSI (MAXIMUM)
(RELIEF 100 PSI)
REG
65 PSI @ 1200 PSI
02 CYLINDER PRESSURE GAUGE
AIR CYLINDER PRESSURE GAUGE
MAIN SUPPLY ON/OFF
02 IN
02 OUT
AIR IN
AIR OUT
FILTER
20 PSI
SUCTION CONTROL 0 TO -150 mmHg
SUCTION ON/OFF
VACUUM GENERATOR
SUPPLY
VACUUM
EXHAUST
Atm
VACUUM GAUGE
-150mmHg ± 20%
SUCTION FILTER
0 TO -150 mmHg @ >16 lpm
SUCTION CATHETER
SUCTION COLLECTION BOTTLE 750 ml
FLOW CONTROL 0 TO 15 lpm ± 3% OF FS OR ± 10% OF SETTING WHICHEVER IS GREATER
160 cmH2O ± 10%
AUXILIARY OUTLET (100% 02)
HOSE BARB 0.300" DIA
AIRWAY PRESSURE GAUGE
GAUGE PORT
PRIMARY OUTLET
GAS SUPPLY MODULE - 02 ONLY
02
BLENDER MODULE (OPTIONAL)
02 IN BLENDER TO SIDE PORT TEE OF RESUS MODULE.
02 INPUT
AIR INPUT
LOW FLOW BLENDER
MIXED GAS OUTPUT
AIR PORT IN GAS SUPPLY TO AIR OF BLENDER.
02/AIR MIX PORT IN BLENDER TO 02/AIR MIX PORT OF RESUS MODULE.
SYSTEM CONSTRAINTS:
1.SYSTEMS WITH A BLENDER SHALL HAVE 02/AIR GAS SUPPLY CIRCUIT.
2.SYSTEM WITH 02/AIR GAS SUPPLY MODULE SHALL HAVE A BLENDER.
* 3.SYSTEM W/O BLENDER,CONNECT SMALL TUBE FROM SIDE PORT TEE OF RESUS MOD TO 02/AIR BLEND PORT OF RESUS MOD.

PNEUMATIC SCHEMATIC,
GAS DELIVERY MODULE

Hill-Rom® Air-Shields

A HILLENBRAND INDUSTRY

INSTRUCTIONS

INSERT THIS SHEET INTO THE MANUAL DESCRIBED BELOW.

REASON FOR CHANGE

ADD REFERENCES FOR RESUSCITATION CALIBRATION

EQUIPMENT: **Resuscitaire Radiant Warmer Model RW82**

MANUAL TITLE: **Service Manual**

MANUAL CAT. NO.: **82 990 07 – 7**

ADDENDUM INFORMATION

SECTION 3 PAGE 3-18 RESUSCITATION MODULE. ADD THE FOLLOWING TO THE CAUTION:

Refer to paragraph 5.12 on page 5-44.

SECTION 5 PAGE 5-2. PARAGRAPH 5.2.2 RESUSCITATION CALIBRATION.

Change to read as follows:

Refer to paragraph 5.12 on page 5-44.

PLEASE READ

Please check the A page for change information.

Since Hill-Rom Air-Shields, Inc. conducts a continuous product improvement program, circuit and component improvements are sometimes incorporated into equipment before they can be incorporated into the printed manuals. When this occurs, changed material is provided on separate sheets at the rear of the manual or under separate cover in the form of a change package. Changed material on each page of text is indicated by a vertical bar in the margin next to the changed material, as shown on the right.

THIS MANUAL CONTAINS PROPRIETARY INFORMATION. REPAIRS AND AUTHORIZED MODIFICATIONS SHOULD BE PERFORMED ONLY BY QUALIFIED SERVICE PERSONNEL TO MAINTAIN YOUR WARRANTY AND TO AVOID CREATING SAFETY HAZARDS. WE CANNOT ASSUME RESPONSIBILITY FOR ANY CONDITIONS AFFECTING THE PROPER OPERATION OF THIS EQUIPMENT WHICH MAY RESULT FROM UNAUTHORIZED REPAIR OR MODIFICATION.

NOTE ON REPLACEMENT PARTS

Some parts used in your equipment may be different than those which appear in the Parts List of this manual. This sometimes occurs due to difficulty in parts procurement, but does not alter the function of the equipment. Order the part listed in the Parts List. Refer to Section 6 of this Manual for a listing of recommended spare parts.

NOTE: ALSO SEE PAGE 2.

LIST OF AVAILABLE MODIFICATION KITS

ITEM	DESCRIPTION AND PURPOSE	PART NO.
01	RETROFIT KIT, COLUMN WITH PNEUMATICS (NO AUTOBREATH, BLENDER, NIST GAS FITTINGS)	81 900 15

LIST OF EFFECTIVE PAGES

PAGE NO.	CHANGE NO.	DATE OF ISSUE
Front Cover	6	12/99
Warranty Page	6	12/99
1	3	10/98
2	0	10/96
A	6	12/99
B	5	9/99
i thru v	0	10/96
vi thru x	2	6/98
1-1 thru 1-3	0	10/96
1-4	2	6/98
2-1 thru 2-3	0	10/96
2-4	2	6/98
2-5 thru 2-10	0	10/96
3-1	3	10/98
3-2 thru 3-20	0	10/96
4-1	5	9/99
4-2 and 4-3	0	10/96
4-4 and 4-5	5	9/99
4-6	0	10/96
5-1	1	8/97
5-2	0	10/96
5-3	6	12/99
5-4 thru 5-17	0	10/96
5-18 and 5-19	5	9/99
5-20 thru 5-27	0	10/96
5-28	1	8/97
5-29	0	10/96
5-30	2	6/98
5-31	0	10/96
5-32	2	6/98
5-33	1	8/97
5-34 thru 5-52	0	10/96
6-1 and 6-2	2	6/98
6-3 and 6-4	0	10/96
6-5	3	10/98
6-6 and 6-7	2	6/98

LIST OF EFFECTIVE PAGES (continued)

PAGE NO.	CHANGE NO.	DATE OF ISSUE
6-8	0	10/96
6-9	3	10/98
6-10 thru 6-12	0	10/96
6-13	2	6/98
6-13A	1	8/97
6-13B	2	6/98
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6-15	1	8/97
6-16	2	698
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6-17A thru 6-17O	2	6/98
6-17P and 6-17Q	5	9/99
6-17R	2	6/98
6-17S thru 6-17X	5	9/99
6-20 thru 6-22	1	8/97
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6-40	1	8/97
6-41	2	6/98
6-42	1	8/97
6-43 and 6-44	0	10/96
6-45	3	10/98
6-46	1	8/97
6-47 and 6-48	0	10/96
6-49	2	6/98
6-50	1	8/97
6-51 thru 6-56	0	10/96
7-1 thru 7-4	0	10/96
7-5 and 7-5A	1	8/97
7-6 and 7-7	1	8/97
7-8 and 7-9	0	10/96
7-10	2	6/98

LIST OF DEFINITIONS AND SYMBOLS

TECHNICAL DEFINITIONS

RESUSCITATOR. A portable device used in emergency situations to provide assisted ventilation to individuals whose respiration is inadequate. The Resuscitation Module used in the **Resuscitaire® Radiant Warmer** contains pneumatic circuitry necessary for infant resuscitation.

PNEUMATICS. Dealing with the properties of air and other gases. The following pneumatic circuits are contained in the optional Resuscitation Module: a suction circuit, a patient Oxygen delivery circuit and an auxiliary Oxygen delivery circuit.

BLENDER. A device which provides a specific mixture of Air and Oxygen. The Blender Module is an option that can be used in the **Resuscitaire® Radiant Warmer**. The Blender Module provides an O_2 Concentration from 21 to 100% through the Patient Outlet.

OFF–LINE DIAGNOSTIC. A series of 18 tests, embedded in the internal software of the Controller, which enable the user to test the operation of the **Resuscitaire® Radiant Warmer** when the equipment is not in the Operating Mode.

NOTE, IMPORTANT, CAUTION AND WARNING

NOTE: *A NOTE is inserted in text to point out procedures or conditions which may otherwise be misinterpreted or overlooked. A NOTE may also be used to clarify apparently contradictory or confusing situations.*

IMPORTANT: *Similar to a NOTE but used where greater emphasis is required.*

CAUTION: A CAUTION is inserted in text to call attention to a procedure which, if not followed exactly, can lead to damage or destruction of the equipment.

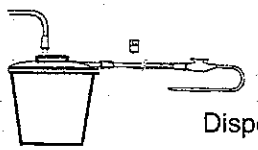
WARNING: A WARNING is inserted in text to call attention to dangerous or hazardous conditions inherent to the operation, cleaning, and maintenance of the equipment which may result in personal injury or death of the operator or patient.

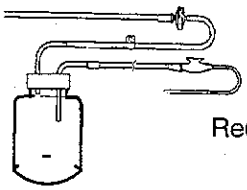
SYMBOLS

Attention: consult accompanying documents.

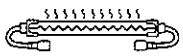
Type B equipment with an F-type isolated (floating) applied part.

Danger! High Voltage!


Disposable Suction Bottle

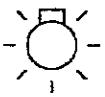

Reusable Suction Bottle

Patient


Heater Element

Suction Line Filter

Load Symbol


Examination Light

Examination Light Switch

Mode Control Key

Temperature Override Mode Key

Keypad Lock Key

Set Temperature Keys

Power On/Off Switch

Celsius/Fahrenheit Selection Key

Silence/Reset Key

Procedural Silence Indicator

Apgar Timer Reset Key

Apgar Timer Start/Stop Key

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides the instructions for installation, maintenance and repair of the **Resuscitaire® Radiant Warmer**.

This manual is intended for use only by trained, qualified service personnel. Instructions for the operation of the equipment are provided in a separate Operator's Manual.

1.2 DESCRIPTION

The **Resuscitaire® Radiant Warmer** System is designed specifically for NICU and Labor and Delivery room use. The **Resuscitaire® Radiant Warmer** consists of a Bassinet, a Warmer, and a Controller Module which provides heat control, monitoring of skin temperature and Apgar timing. The **Resuscitaire® Radiant Warmer** also includes a basic resuscitation package which includes suction and Oxygen delivery.

1.3 OPTIONS/ACCESSORIES

The options and accessories available for the **Resuscitaire® Radiant Warmer** are listed below and illustrated in Figure 1.1. Refer to Section 6 for Replacement Parts and Part Numbers.

FACTORY INSTALLED OPTIONS

- Resuscitation Module
- Resuscitation Module with AutoBreath Infant Resuscitator
- Integrated Precision Blender
- Gas Supply Module
  - O_2 Pipeline and Cylinder
  - O_2/Air Pipeline and Cylinder

FIELD INSTALLED ACCESSORIES

- Instrument Tray left
- Instrument Tray right
- X-Ray Cassette Tray
- Pass-Through Drawer Organizer Tray
- I.V. Pole
- Monitor Shelf

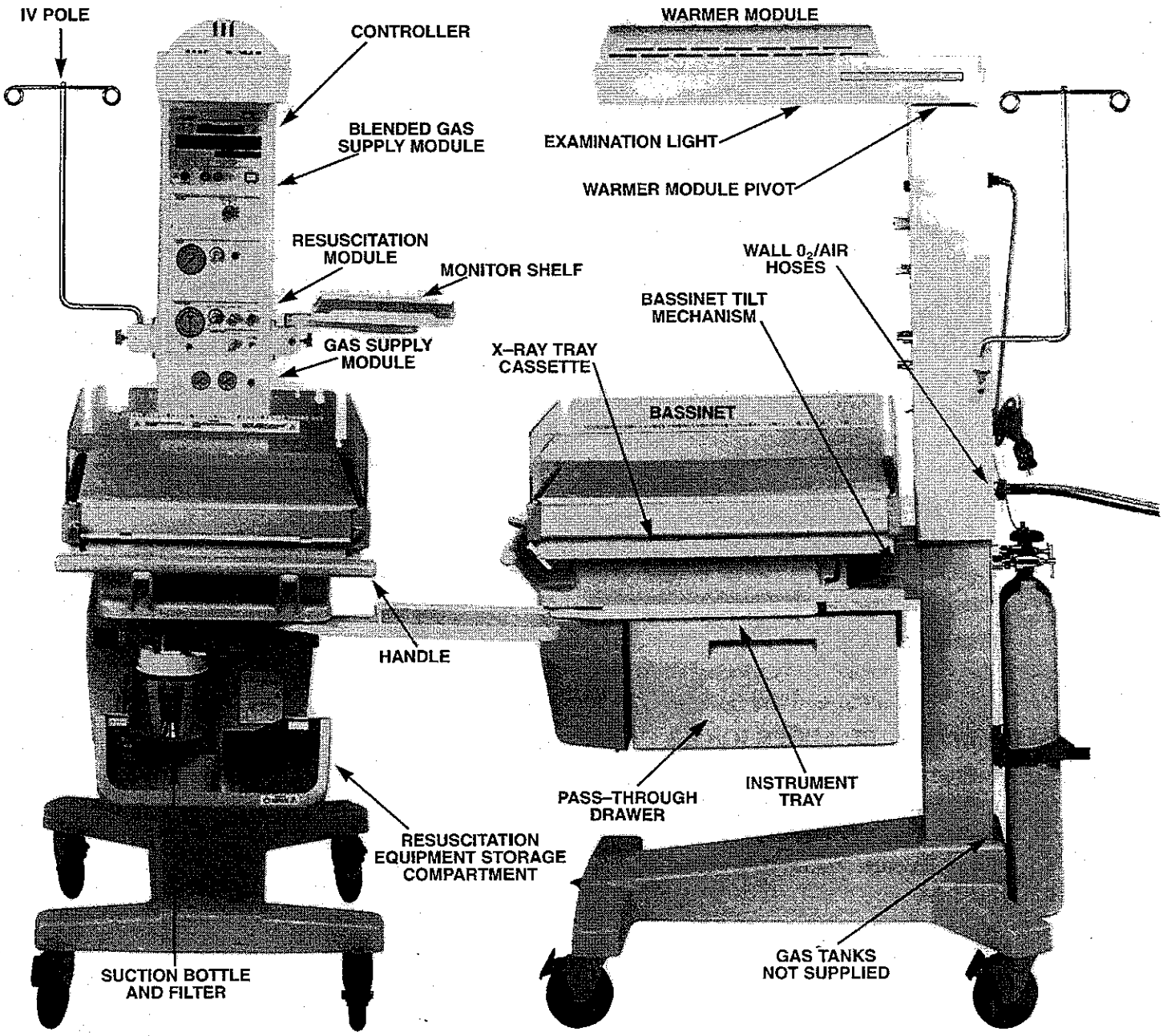


FIGURE 1.1: EQUIPMENT PROVIDED WITH FACTORY INSTALLED OPTIONS AND FIELD INSTALLED ACCESSORIES

1.4 MODEL IDENTIFICATION SERIES CHANGE

The **Resuscitaire® Radiant Warmer** has six Data Tags which list the model identification and series numbers of the equipment. The locations of the Data Tags are as follows:

RESUSCITATION MODULE – inside of upper bracket or rear of module.

ELECTRONIC MODULE – rear of the module.

BLENDER MODULE – inside of chassis.

GAS SUPPLY MODULE – outside of chassis

RADIANT WARMER – right side of the lower column.

WARMER MODULE – rear of heater head pivot bracket.

The following example explains the content of the data tag:

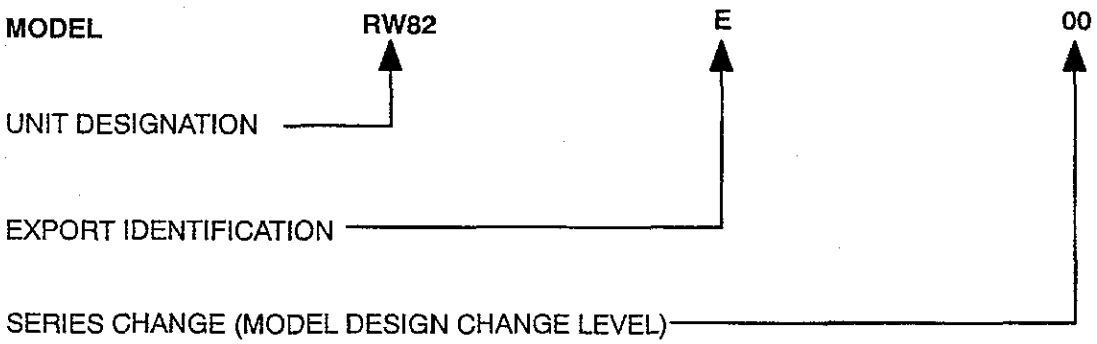


TABLE 1.1: SERIES CHANGE – RESUSCITAIRE® RADIANT WARMER, MODEL NOs. RW 82-1, 1C AND 1E

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	New Resuscitation Module	All

TABLE 1.2: SERIES CHANGE – RESUSCITATION MODULE, MODEL NOs. RM811-1 AND RM812-1

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	Incorporated Airway Pressure Gauge Port	81 400 72 , 81 400 72R* and 81 400 81
02	New Resuscitaire Design	81 400 73 and 81 400 73R *

*R-denotes reworked module

TABLE 1.3: SERIES CHANGE – GAS SUPPLY MODULE, MODEL NOs. GS811-1, GS812-1, GS813-1 AND GS814-1

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None

TABLE 1.4: SERIES CHANGE – BLENDER MODULE MODEL NO. BL81-1

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None

TABLE 1.5: SERIES CHANGE – CONTROLLER MODULE MODEL NOs. EM81-1 AND 1E

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	Removal of Capacitor from Circuit Breaker	81 300 70, 80, 83

TABLE 1.6: SERIES CHANGE – WARMER MODULE MODEL NOs. WM81-1 AND 1E

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	Add Filter Assy	81 200 71, 81, 84

TABLE 1.7 SERIES CHANGE – RESUSCITAIRE® RADIANT WARMER, MODEL NOs RW82 VHA-1,1C AND 1E

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None

TABLE 1.8 SERIES CHANGE – RESUSCITAIRE® RADIANT WARMER CART ASSEMBLY, MODEL NOs 82 VHA-1 AND 1C

SERIES NO.	DESCRIPTION	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None

SECTION 2
INSTALLATION

2.1 UNPACKING

The **Resuscitaire® Radiant Warmer** is shipped in one carton which contains the following assemblies:

- Bassinet/Cart Assembly
- Upper Post Assembly
- Warmer Module Assembly
- Any user installed accessories that were ordered

When removing the equipment from the carton, use care not to scratch or otherwise damage unprotected surfaces; remove all packing material.

2.2 ASSEMBLY (Refer to Figure 2.1)

NOTE: *The required mounting hardware is stored in a bag located in the pass-through drawer.*

1. **REMOVE THE BACK COVER** (1) from the Upper Column (2).
2. **REMOVE THE CONTROLLER** (3) from the Upper Column.
3. **REST THE UPPER COLUMN** on top of the Bassinet/Cart Column opening.
4. **CONNECT THE SUCTION HOSE** (4) to the Suction Hose (11).
5. **REPOSITION AND MOUNT THE UPPER COLUMN** on the Bassinet/Cart using the four 10 – 32 x 3/8 inch screws (5) provided.
6. **INSTALL TWO 10 – 32 X 3/8 INCH SCREWS (6) IN THE UPPER HOLES OF THE UPPER COLUMN**. Do not tighten the screws.
7. **RAISE THE WARMER** (7) above the open end of the Upper Column and insert the Power Cable (10) into the open end of the column.
8. **SLOWLY LOWER THE WARMER** onto the Upper Column. Align the slots of the Warmer over the screws on the column. Install the screws on the pivot bracket. Tighten the screws on the upper holes of the column using a nine-inch Phillips Head screwdriver.
9. **THREAD THE WARMER POWER CABLE** out through the Controller opening. Connect the Power Cable to connector J4 on the Controller.
10. **REMOUNT THE CONTROLLER** on the Upper Column. Remount the Back Cover on the Upper Column.
11. **CONNECT THE LINE CORD** to the Power Connector on the rear of the Controller.
12. **SECURE THE LINE CORD** to the Back Cover using the Cable Clamp (8) and 8 – 32 x 3/8 screw (9).

    CAUTION: Securing the Line Cord to the Back Panel is required to prevent removal of the Controller chassis with the ac power applied.

13. **INSTALL ANY ACCESSORIES** that were ordered using the installation instructions provided with the accessory.
14. **INSTALL THE END AND SIDE PANELS** on the Bassinet (refer to Paragraph 4.5 and Figures 4.1 and 4.4).

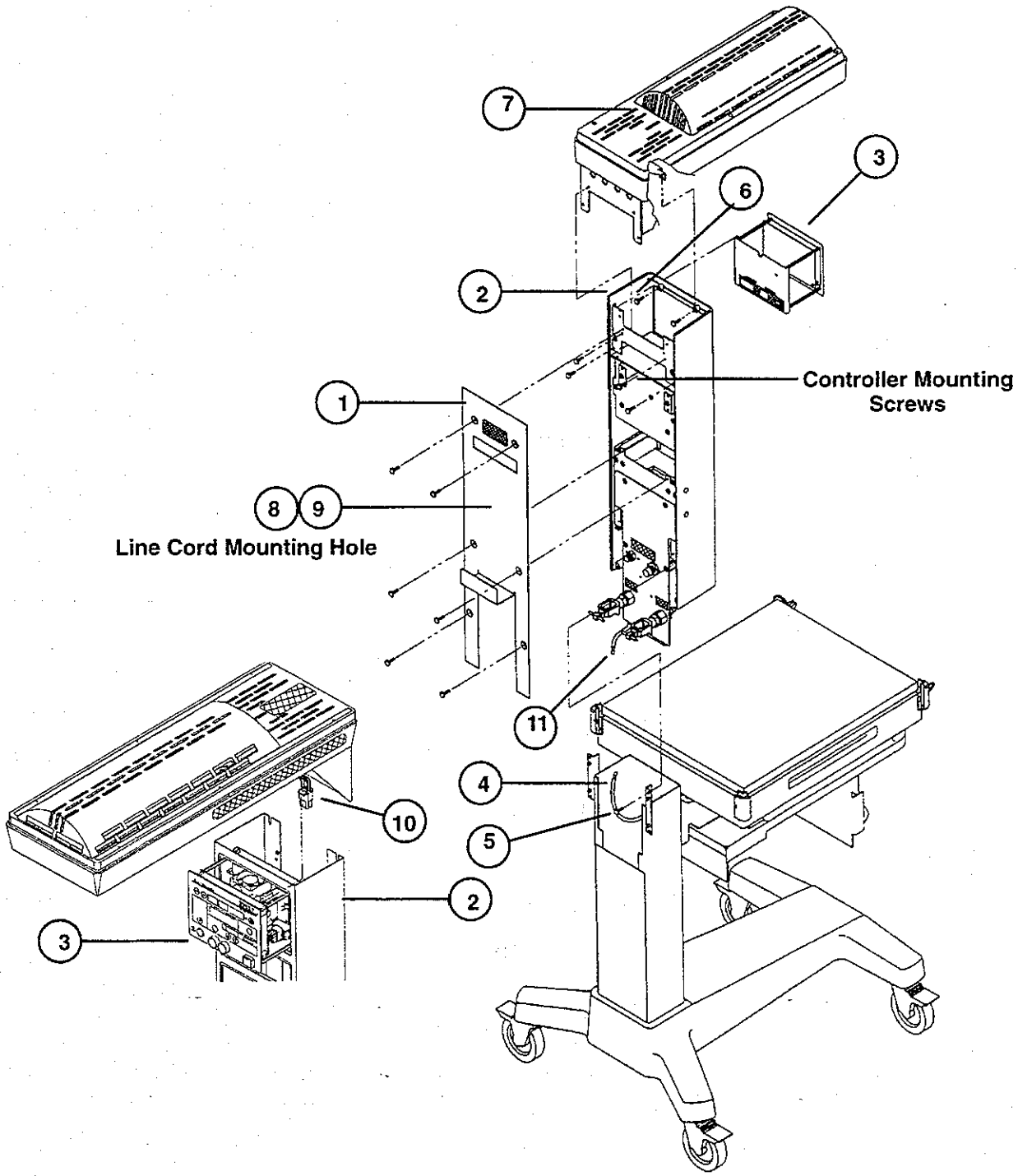


FIGURE 2.1: INSTALLATION

2.3 OPERATIONAL CHECKOUT PROCEDURE – CONTROLLER

WARNING: The Warmer should not be used if the Controller fails to function as described below. A potential shock hazard exists within the Warmer Module. Refer to Section 5 of this Manual.

CAUTION: HEAVY EQUIPMENT – To prevent injury or damage to the Warmer, two persons of sufficient strength are required to adequately control the Warmer during transport.

IMPORTANT: *Before attempting to perform this procedure, refer to Section 4 of the Operator's Manual.*

NOTE: *The Operational Checkout Procedure should be performed before each use and after disassembly for cleaning, servicing or maintenance.*

1. **CONNECT THE AC LINE CORD TO THE POWER CONNECTOR** on the Controller Rear Panel.

WARNING: Connect the power cord only to a properly grounded wall receptacle that is approved for hospital–use and of the correct voltage. DO NOT use extension cords or an ac Receptacle Box for this device.

2. **CHECK THE SELF–TEST FUNCTION.** Turn *On* the **Power Switch**. The Self–Test Function should be initiated and the following should occur:

   - **Apgar Timer, Baby Temperature** and **Set Temperature Digital Displays** show all eights
   - All **Alarm Indicators** (except Power Fail)
   - All **Mode Indicators** light
   - The **> 37 °C Indicator** lights
   - All ten segments of the **Heater Power Indicator** light
   - The **Procedural Silence Indicator** lights
   - The **Keypad Lock Switch** lights
   - The audible alarm will sound a high pitch tone, a low pitch tone, then a beep–beep–beep

   When the Self–Test Function is complete, the Controller should begin operating in the **Pre–Warm Mode**.

3. **CHECK THE PRE–WARM MODE.** The **Pre–Warm Indicator** should be *On* and the **Heater Power Indicator** should display 10 segments (100%) for three minutes, reduce to 6 segments (60%) for 12 minutes, then reduce to 3 segments (30%).

4. **CHECK THE MANUAL MODE.** Select **Manual Mode** by pressing the **Mode Select Key**. The **Manual Indicator** should light.

   Press the **Up Arrow Key** until all the **Heater Power Display** segments are lit. Press the **Down Arrow Key** until all the **Heater Power Indicators** are *Off*. Connect the Skin Temperature Probe to the **Skin Temp Probe** Connector, the **Baby Temperature Display** should come *On*.

Set the **Heater Power Indicator** to 100%, all segments are lit. Wait 10 minutes. After 10 minutes have elapsed, the **Chk Patient Indicator** should come *On* and the audible alarm should sound one time. Wait an additional 5 minutes. During this time the audible alarm should sound at 30-second intervals. At the end of 5 minutes (15 total), the heater should shut down and the **Heater Power Indicators** should go *Off* and the audible alarm should sound continuously and ramp up in volume. Press the **Silence/Reset Key**, the **Chk Patient Indicator** and audible alarm should go *Off* and the heater should come back on along with the **Heater Power Indicators**.

5. **CHECK THE KEYPAD LOCK.** Press the **Keypad Lock Switch**. The **Keypad Lock Switch** should light up. The **Mode Key** and the **Up/Down Arrow Keys** should be inoperative. Press the **Keypad Lock Switch**. The **Keypad Lock Switch** light should go *Off* and the Keypad should be enabled.

6. **CHECK THE BABY MODE.** Select **Baby Mode** by pressing the **Mode Select Key**. The **Baby Indicator** should light and the **Set Temperature Display** should activate and default to 36.5 °C. In addition, the **Baby Temp Indicator** should flash and the audible alarm should sound. Press the **Silence/Reset Key**, the audible alarm should go *Off* for ten minutes, the **Baby Temp Indicator** should remain *On*.

   Then raise the Skin Probe temperature reading until it exceeds the set temperature by at least 1 °C. The **Baby Temp Indicator** should flash and the audible alarm should sound. Press the **Silence/Reset Key**, the audible alarm should go *Off* for ten minutes, the **Baby Temp Indicator** should remain *On*.

7. **CHECK THE TEMPERATURE OVERRIDE MODE.** Press the **Up Arrow Key** to raise the **Set Temperature** to 37.0 °C. Press the **>37 °C Key**, the **>37 °C Indicator** should come *On*. Press the **Up Arrow Key** again to raise the Set Temperature to 38.0 °C.

   Press the **Down Arrow Key** to lower the Set Temperature to below 37.0 °C. When the **Set Temperature** falls below 37.0 °C, the **>37 °C Indicator** should go *Off*.

8. **CHECK THE PROBE ALARM.** Disconnect the Skin Temperature Probe from the **Skin Temp Probe** Connector. The **Baby Temperature Display** should go *Off*, the **Probe Indicator** should flash and the audible alarm should sound. Replace the probe.

9. **CHECK THE APGAR TIMER.** Press the **Start/Stop Key**, the **Apgar Timer Display** should come *On* and begin to count up from zero seconds. Press the **Start/Stop Key**, the **Apgar Timer** count should stop. Press the **Reset Key**, the **Apgar Timer Display** should go *Off*.

10. **CHECK THE EXAMINATION LIGHT.** Press the **Exam Light Switch**. The Examination Light should come on. Press the **Exam Light Switch** again, the Examination Light should go *Off*.

11. **CHECK THE POWER FAIL ALARM.** Turn *Off* the **CIRCUIT BREAKER** on the Rear Panel. Turn *On* the **Power Switch** on the Front Panel. The **Power Fail Indicator** should come *On* and the audible alarm should sound. Turn *Off* the **Power Switch** and turn *On* the **CIRCUIT BREAKER.**

    NOTE: *The Unit must be connected to the ac line and the power turned On for at least eight minutes before the Power Fail Circuitry becomes active.*

12. **CHECK THE HIGH TEMP ALARM.** Raise the skin temperature reading on the display until it is ≥ 39 °C. The heater should automatically shut off, the **High Temp Indicator** should flash and the audible alarm should sound continuously until the skin temperature reading is ≤ 38.5 °C or the **Silence/Reset Key** is pressed.

2.4 MECHANICAL CHECKOUT

1. **CHECK THE MATTRESS TILT CONTROL** (Figure 2.2) by pulling up on the lever, located at the bottom rear of the Bassinet, while supporting the rear lower edge of the Bassinet with the palm. Place the Bassinet in the 5–degree and then the 10–degree tilt position; return the Bassinet to the level position.

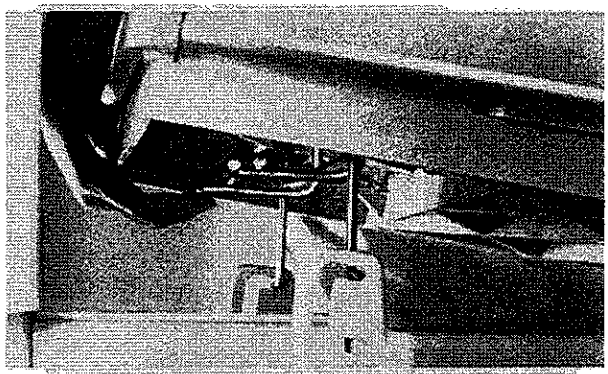


FIGURE 2.2: CHECKING THE BASSINET TILT CONTROL

2. **CHECK THE BASSINET SIDE PANELS** (Figure 2.3) by raising each panel and pivoting it to hang straight down. Return the panel by reversing the procedure. Check that the panel is positively engaged to confine the infant.

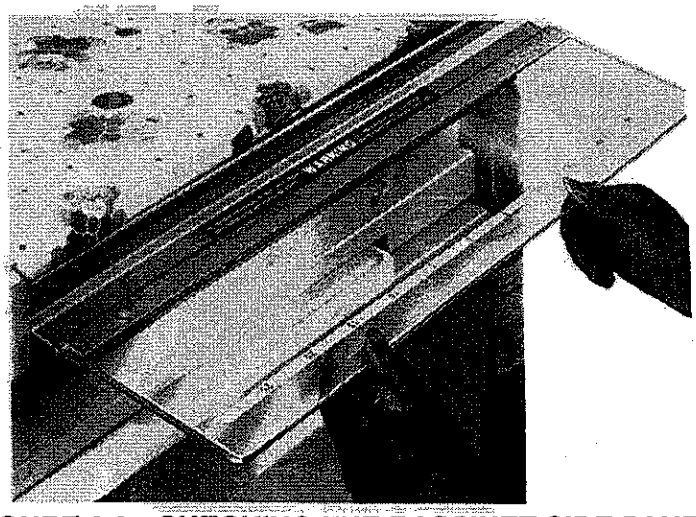


FIGURE 2.3: CHECKING THE BASSINET SIDE PANELS

3. **CHECK THE BASSINET FRONT PANEL** (Figures 2.4 and 2.5) by raising the panel and sliding it under the mattress. Return the panel by reversing the procedure. Check that the panel is positively engaged to confine the infant.

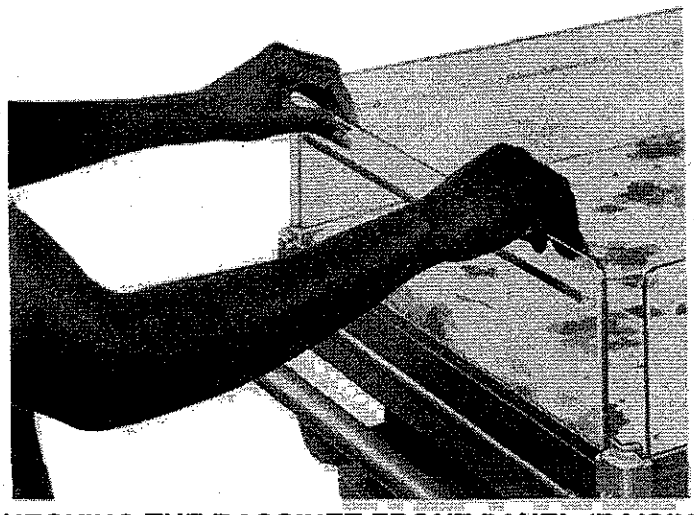


FIGURE 2.4: CHECKING THE BASSINET FRONT PANEL (RAISING THE PANEL)

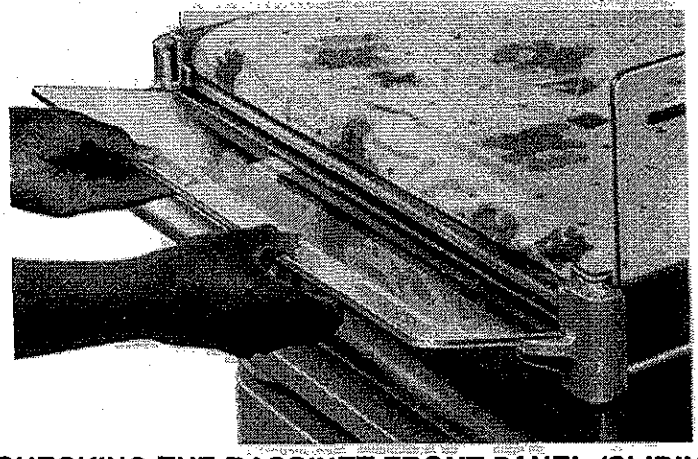


FIGURE 2.5: CHECKING THE BASSINET FRONT PANEL (SLIDING THE PANEL)

4. **CHECK THE PASS-THROUGH DRAWER** (Figure 2.6) by sliding the drawer in and out on both sides of the Bassinet. Return to the center position.

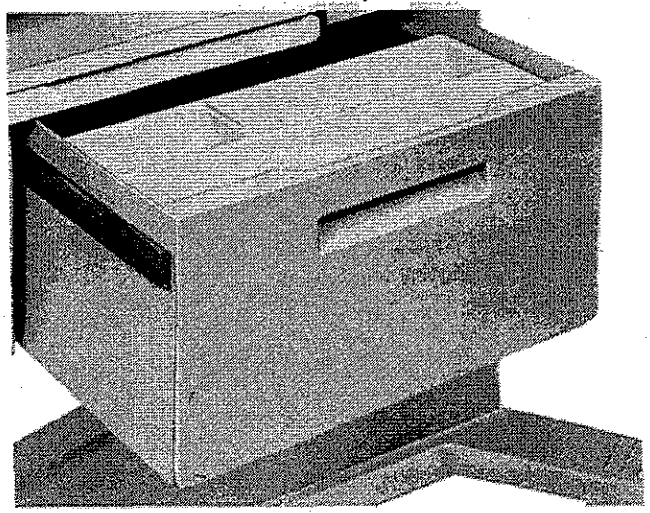


FIGURE 2.6: CHECKING THE PASS-THROUGH DRAWER

5. **CHECK THE WARMER MODULE SWIVEL OPERATION** (Figure 2.7) by rotating the Warmer Module 90 degrees to the left and right of center. Return to center position.

   PRECAUTION: *For effective heating, make sure the Warmer Module is positioned on the center axis and locked with detent.*

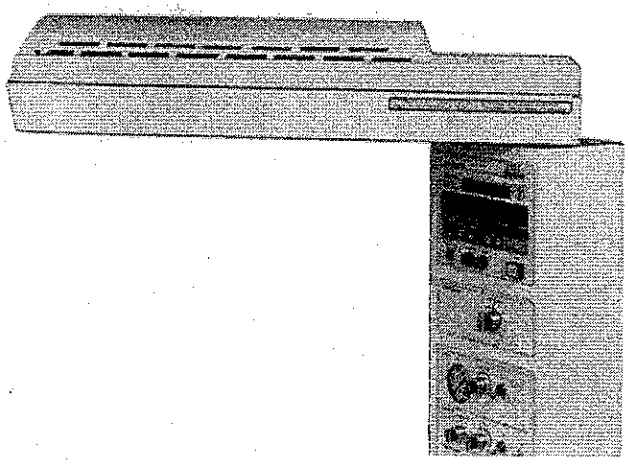


FIGURE 2.7: CHECKING THE WARMER MODULE SWIVEL

6. **CHECK THE OPERATION OF THE X-RAY CASSETTE TRAY (ACCESSORY),** in Figure 2.8, by grasping the middle of a Side Panel and pulling the X-Ray Cassette Tray out from under the Bassinet. Replace the X-Ray Cassette Tray by reversing the procedure.

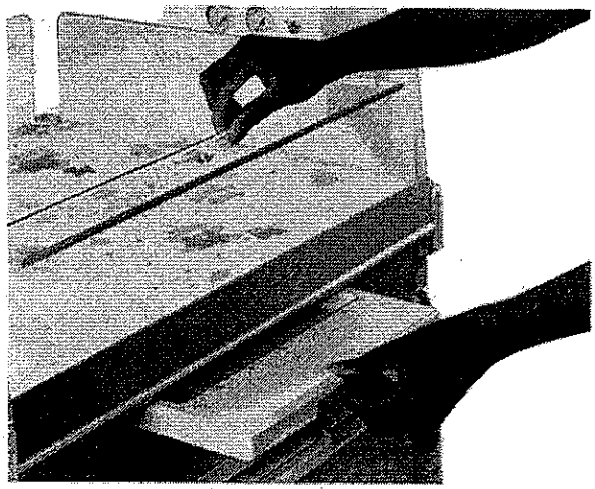


FIGURE 2.8: CHECKING THE X-RAY TRAY

7. **CHECK THE INSTRUMENT TRAY (ACCESSORY)** (Figure 2.9) by swinging it out from under the Bassinet.

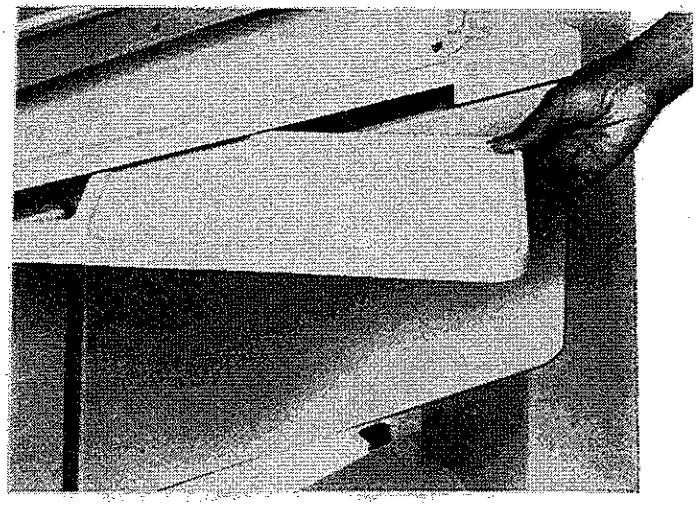


FIGURE 2.9: CHECKING THE INSTRUMENT TRAY

2.5 RESUSCITATION EQUIPMENT PRE-USE CHECKOUT/SET-UP

WARNING:

- **For prolonged ventilation, use of a heat and moisture exchanger is recommended.**
- **Excessive air pressure can cause damage to the patient's lungs. Always monitor airway pressure and/or provide appropriate pressure relief during resuscitation.**

SUPPLY PRESSURE

1. Ensure that O_2 (and AIR) pipeline(s) are securely attached to appropriate fittings on the rear of the unit and that the gas supply present is 40 to 75 psi.

If using Reserve Gas Supplies from cylinders:

2. Ensure that each cylinder is properly secured on the rear of the Warmer and that the cylinder valve located on the top of the cylinder is open.
3. Examine the appropriate **Cylinder Pressure Gauges** on the front of the Upper Column to ensure that a sufficient reserve gas supply is present.
4. Set the **Gas Supply On/Off Switch** to the *On* position.

BLENDED GAS SUPPLY PRE-USE CHECKOUT AND SETUP (Optional)

LOW FLOW MICROBLENDER WARNINGS:

- **If either the Air or Oxygen gas source pressure is reduced or increased, creating a pressure differential of 30±5 psi, the microblender alarm will sound. This condition significantly alters the FiO_2 and flow output from the microblender.**
- **Always operate the low flow microblender with clean/dry medical grade gases.**
- **Air inlet water filters are recommended for use with the low flow microblender.**
- **The concentration of Oxygen provided and the partial pressure of Oxygen within the patient's blood (PaO_2) should be monitored.**

1. If present, set the Precision Blender to the desired % Oxygen Concentration using the **Blender Control Knob.**
2. Remove either the Oxygen or Air supply (pipeline or cylinder). The Blender alarm should sound. Replace the supply.
3. Set the Blender to the desired % Oxygen Concentration.

RESUSCITATION MODULE PRE-USE CHECKOUT AND SETUP (Optional)

Suction

1. Check that a clean Suction Bottle (reusable or disposable, Figure 2.10) is installed and properly connected in the Resuscitation Equipment Storage Compartment at the front of the Warmer.

   CAUTION: When installing the disposable Suction Bottle: to prevent the suction tube from being blocked or damaged, position the Outlet Port parallel to the plate (Figure 2.10).

2. Ensure that a bacterial filter (reusable Suction Bottle) is connected in-line with the supply connection to the reusable Suction Bottle (a filter is built-in on the disposable bottle).

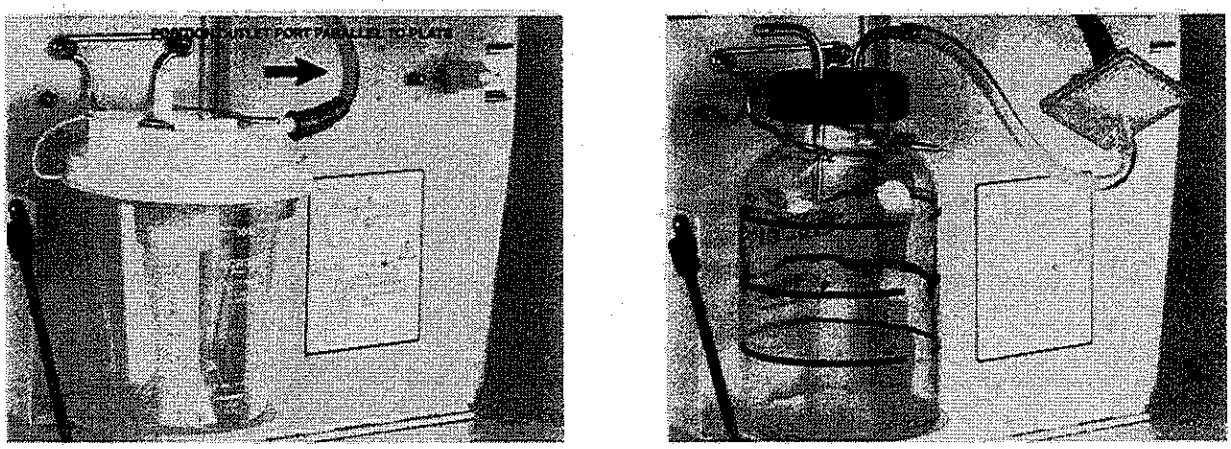


FIGURE 2.10: CHECKING THE SUCTION BOTTLE

3. Connect the desired extension tubing to the outlet of the Suction Bottle Outlet Port (refer to Figure 3.2) and secure the free end of the extension tubing in either tubing retaining slot provided on the Front Panel of the Bassinet.
4. Turn *On* the **Suction On/Off Switch**. There may be an initial reading of up to 30 mmHg on the Suction Gauge (refer to Figure 3.2) due to the flow of resistance of the hydrophobic filter and suction tubing.

   NOTE: *The filter and tubing resistance will not affect the desired maximum pressure value that is set in Step 5 below. The pressure value of the Suction Gauge matches the actual pressure valve at the end of the catheter.*

5. Block the Patient Outlet of the Suction Bottle. Adjust the suction magnitude using the **Suction Min/Max Control** while viewing the suction level on the **Suction Gauge.** Adjust the suction magnitude to the desired maximum suction pressure value.
6. Turn *Off* the **Suction On/Off Switch.**

Resuscitation Module Without AutoBreath (Optional)

Manual Resuscitation – Use with Patient Breathing Circuit – 10 mm tubing with thumb hole (finger) at patient end (refer to Figure 3.7).

There are potential hazards associated with the delivery of supplemental Oxygen. If it is necessary to administer Oxygen, the attending physician should be notified immediately.

1. Connect the Patient Circuit to the **Patient Outlet** (refer to Figures 3.6 and 3.7).
2. Adjust the flow rate to the desired fresh gas flow rate using the **Patient Supply Flow Rate (LPM) Control.**
3. Set the adjustable **Airway Pressure Relief Control** to the desired pressure limit according to the color coded bands on the Airway Pressure Gauge and **Airway Pressure Relief Control.** Alternatively, a "T" fitting with an airway pressure monitor port can be inserted into the **Patient Outlet Port** and connected to the **Airway Pressure Fitting** to indicate the breathing circuit pressure. Adjust the **Airway Pressure Relief Control** as necessary (refer to Figures 3.5, 3.6 and 3.7).

Resuscitation Module With AutoBreath (Optional)

Automatic Resuscitation (Resuscitation Module with Autobreath Infant Resuscitator Only)– Use with Automatic Patient Circuit –10 mm tubing with exhalation valve and exhalation valve control line tubing (refer to Figure 3.4).

1. Turn the **Autobreath Infant Resuscitator** circuit *Off* using the On/Off Control.
2. Connect the Patient Circuit for automatic breathing to the **Patient Outlet Connector** and the exhalation valve control line tubing to the **Exh Valve Connector** (refer to Figures 3.3 and 3.4).
3. Adjust the flow rate to the desired fresh gas flow rate using the **Patient Supply Flow Rate (LPM) Control.**
4. Check the fixed internal Airway Pressure Relief Valve by setting the desired airway pressure limit, with the **Airway Pressure Relief Control** and blocking the exhaust (6) and patient (7) ports on the Exhalation Valve, of the Patient Breathing Circuit (refer to Figures 3.3 and 3.4).
5. Observe the **Airway Pressure Gauge** to check the pressure limit.
6. Turn *On* the Autobreath Infant Resuscitator Circuit.
7. Adjust the **Breath Rate** (BPM) **Control** to 18 breaths per minute.
8. Set the PEEP threshold by blocking the Patient Port (7) of the Patient Breathing Circuit. Do not block the Exhalation Valve Exhaust Port (6). Observe the Positive End Expiratory Pressure indicated on the **Airway Pressure Gauge** and adjust the desired PEEP using the **PEEP Control.** Refer to Figures 3.3 and 3.4.
9. Check the I:E ratio by measuring the Inspiratory and Expiratory Phase Times and dividing the Expiratory Phase Time by the Inspiratory Phase Time. The result should be approximately 2.0.
10. Check the desired Breath Rate by counting the number of breath cycles per minute.

AUXILIARY FLOW (provides 100% Oxygen only)

1. Connect the desired device to be supplied by the Auxiliary Flow Circuit to the **Aux. Outlet Connector.**
2. Adjust the desired Auxiliary Flow using the **Aux. Flow (LPM) Control** and check for flow.

SECTION 3
TECHNICAL INFORMATION

3.1 SPECIFICATIONS

This Service Manual is intended to apply to the full product range and not only CE Marked Versions. Service Manuals may include information relative to 100/120V product variates and options and accessories available for products bearing the CE Mark. Any questions related to this should be referred to Hill-Rom Air-Shields' Technical Services Group or authorized service dealers.

The specifications for the **Resuscitaire® Radiant Warmer** are provided in Tables 3.1A and B. All specifications are subject to change without notice.

TABLE 3.1A: SPECIFICATIONS

POWER REQUIREMENTS

120V Models (North America)	120V, 60 Hz, 750W
100V Models (Japan)	100V, 50/60 Hz, 750W
230V Models (IEC)	220/240V, 50/60 Hz, 750W

OVERLOAD PROTECTION

120V Models (USA)	Dual 12A Circuit Breakers
100V Models (Japan)	Dual 12A Circuit Breakers
230V Models (IEC)	Dual 6A Circuit Breakers

CHASSIS LEAKAGE CURRENT

100V and 120V Models	Less than 300 µA
220V and 240V Models	Less than 500 µA

EXAMINATION LIGHT ..... >100 Foot Candles (0.11 lumens/cm^2)

ALARMS

High Temperature	Activates if Skin Temperature Probe is attached and the skin temperature sensor reaches 39.0 °C. Resets at 38.5 °C.
Chk Patient	Activates in Manual Mode after 10 minutes. Remains on with audible alarm every 30 seconds for 5 minutes; totalling 15 minutes. Then the heater is turned *Off*.
Apgar Timer	Activates at the 1-, 5- and 10-minute Apgar Time intervals.
Power Fail	Activates when there is a loss of power.
Probe	Activates if Skin Temperature Probe fails (open or short).

TABLE 3.1A: SPECIFICATIONS (CONT.)

ALARMS (cont.)

System Fail ..... Indicates system failure; refer to Paragraph 5.10.

Baby Temp ..... Activates if Baby Temperature fluctuates 1 °C above or below set point.

Electrical Module Audio Alarms ..... Tone Frequency: 1.2 KHz maximum
Three–stage sound level: 15 seconds low, 15 seconds medium, then high.

Blender Module Pneumatic Audio Alarm ..... Vibrating Reed.

DISPLAYS

Skin Temperature Display

Range ..... 18 to 40 °C (64.4 to 104 °F)
Accuracy ..... ± 0.2 °C for 31 °C to 37 °C (88 °F to 98.6 °F)
Resolution ..... 0.1°C (0.5 °F)

Apgar Timer Display

Range ..... 0:00 to 59:59 (min: secs)
Resolution ..... 1 second
Accuracy ..... 0 ± 1 second

MANUAL HEAT CONTROL ..... Adjustable in 10% increments from zero to full power (100 %).

DATA PORT ..... 2400 Bits/second fixed Baud Rate. RS232C Compatible

MATTRESS TILT ..... 0, 5 and 10 degrees

DIMENSIONS AND WEIGHT

Mattress Height ..... 100 cm (39.4 inches)
Height ..... 188 cm (74 inches)
Width (Side to Side) ..... 72.4 cm (28.5 inches)
Depth (Front to Back) ..... 111.8 cm (44 inches)
Weight ..... 91 kg (200 lbs)

ENVIRONMENTAL

Operating Temperature Range ..... 18 °C to 30 °C ambient
Storage Temperature Range ..... – 20 °C to +45 °C ambient
Relative Humidity Operating Range ..... 5% RH to 95% RH, non–condensing

TABLE 3.1A: SPECIFICATIONS (CONT.)

RESUSCITATION (w/AutoBreath, PN 81 400 80; w/o AutoBreath, PN 81 400 72)

Wall Supply Pressure ..... 40 to 75 psi (2.8 to 5.2 bar)

Cylinder Pressure ..... 2900 psi max (199.8 bar)

Cylinder Diameter ..... (4 – 5 inches) 10 –12 cm max

Suction Circuit
Adjustable Suction Intensity ..... 0 to 150 mmHg (0 to 20 kPa)

Patient Gas Supply
Airway Pressure Limit, Operator Adjustable ..... 0 to 50 cm H_2O (4.9 kPa) ± 10 %
Fixed Pressure Relief, Factory Set ..... 60 cm H_2O (5.9 kPa) ± 10 %

Auxiliary Supply
Auxiliary Pressure Limit (w/o AutoBreath) ..... 160 cm H_2O ± 10% (16 kPa ± 10 %) maximum
Auxiliary Pressure Limit (with AutoBreath) ..... 160 cm H_2O ± 10% (16 kPa ± 10 %) maximum

Auxiliary Flow Circuit
Auxiliary Flow Range ..... 0 to 15 lpm
Auxiliary Pressure ..... 160 cm H_2O ± 10% (16 kPa ± 10 %) max.

AutoBreath Circuit (Factory Installed Option)
I/E Ratio ..... Fixed at 1:2 ± 20%
PEEP ..... 0 to 18 ± 4 cm H_2O (1.8 ± 0.4 kPa)
Breath Rate ..... 18 to 60 BPM ± 10% of setting
Adjustable Airway Pressure Relief ..... 0 to 50 ± 5 cm H_2O (4.9 ± 0.5 kPa)
Fixed Maximum Pressure ..... 60 cm H_2O ± 10% (5.9 kPa ± 10%)
Oxygen Consumption ..... 50 lpm max.

RESUSCITATION (w/AutoBreath, PN 81 400 81; w/o AutoBreath, PN 81 400 73)

Wall Supply Pressure ..... 40 to 75 psi (2.8 to 5.2 bar)

Cylinder Pressure ..... 2900 psi max (199.8 bar)

Cylinder Diameter ..... (4 – 5 inches) 10 –12 cm max

Suction Circuit
Adjustable Suction Intensity ..... 0 to 150 mmHg (0 to 20 kPa)

Patient Gas Supply
Airway Pressure Limit, Operator Adjustable ..... 0 to 50 cm H_2O (4.9 kPa) ± 10 %
Fixed Pressure Relief, Factory Set ..... 50 cm H_2O (5.0 kPa) ± 20 %

Auxiliary Supply
Auxiliary Pressure Limit (w/o AutoBreath) ..... 160 cm H_2O ± 10% (16 kPa ± 10 %) maximum
Auxiliary Pressure Limit (with AutoBreath) ..... 40 cm H_2O ± 10% (4 kPa ± 10 %) maximum

Auxiliary Flow Circuit
Auxiliary Flow Range ..... 0 to 15 lpm
Auxiliary Pressure ..... 40 cm H_2O ± 10% (4 kPa ± 10 %) max.

AutoBreath Circuit (Factory Installed Option)
I/E Ratio ..... Fixed at 1:2 ± 20%
PEEP ..... 0 to 18 ± 4 cm H_2O (1.8 ± 0.4 kPa)
Breath Rate ..... 18 to 60 BPM ± 10% of setting
Adjustable Airway Pressure Relief ..... 0 to 50 ± 5 cm H_2O (4.9 ± 0.5 kPa)
Fixed Maximum Pressure ..... 50 cm H_2O ± 10% (5.0 kPa ± 10%)
Oxygen Consumption ..... 50 lpm max.

TABLE 3.1B: SPECIFICATIONS CE MARK VERSION

POWER REQUIREMENTS ..... 220/240V, 50/60 Hz, 750W

OVERLOAD PROTECTION ..... Dual 6A Circuit Breakers

CHASSIS LEAKAGE CURRENT ..... Less than 500 μA

EXAMINATION LIGHT ..... >0.11 lumens/cm^2

ALARMS

High Temperature ..... Activates if Skin Temperature Probe is attached and the skin temperature sensor reaches 39.0 ± 0.2 °C. Resets at 38.5 °C.

Chk Patient ..... Activates in Manual Mode after 10 minutes. Remains on with audible alarm every 30 seconds for 5 minutes; totalling 15 minutes. Then the heater is turned *Off*.

Apgar Timer ..... Activates at the 1–, 5– and 10–minute Apgar Time intervals.

Power Fail ..... Activates when there is a loss of power.

Probe ..... Activates if Skin Temperature Probe fails (open or short).

System Fail ..... Indicates system failure; refer unit to service immediately.

Baby Temp ..... Activates if Baby Temperature fluctuates 1 °C above or below set point.

Electrical Module Audio Alarms ..... Tone Frequency: 1.2 kHz maximum
Three–stage sound level: 15 seconds low, 15 seconds medium, then high.

Blender Module Pneumatic Audio Alarm ..... Vibrating Reed.

DISPLAYS

Skin Temperature Display

Accuracy ..... ± 0.2 °C for 31 °C to 37 °C

Resolution ..... 0.1°C

Apgar Timer Display

Range ..... 0 to 59 minutes, 0 to 59 seconds

Resolution ..... 1 second

Accuracy ..... 0 ± 0.5 second

MANUAL HEAT CONTROL ..... Adjustable in 10% increments from zero to full power (100 %)

DATA PORT ..... 2400 Bits/second fixed Baud Rate. RS232C Compatible

MATTRESS TILT ..... 0, 5 and 10 degrees.

DIMENSIONS AND WEIGHT

Mattress Height ..... 100 cm (39.4 inches)

Height ..... 188 cm (74 inches)

Width (Side to Side) ..... 72.4 cm (28.5 inches)

Depth (Front to Back) ..... 111.8 cm (44 inches)

Weight ..... 91 kg (200 lbs)

ENVIRONMENTAL

Operating Temperature Range ..... 18 °C to 30 °C ambient

Storage Temperature Range ..... – 30 °C to +70 °C ambient

Relative Humidity Operating Range ..... 5% RH to 95% RH, non–condensing

TABLE 3.1B: SPECIFICATIONS CE MARK VERSION (CONT.)

RESUSCITATION (w/AutoBreath, PN 81 400 80; w/o AutoBreath, PN 81 400 72)

Wall Supply Pressure ..... 2.8 to 5.2 bar

Cylinder Pressure ..... 199.8 bar

Cylinder Diameter ..... 10 –12 cm max

Suction Circuit
Adjustable Suction Intensity ..... 0 to 20 kPa

Patient Gas Supply
Airway Pressure Limit, Operator Adjustable ..... 0 to 4.9 kPa ± 10 %
Fixed Pressure Relief, Factory Set ..... 5.9 kPa ± 10 %

Auxiliary Supply
Auxiliary Pressure Limit (w/o AutoBreath) ..... (16 kPa ± 10 %) maximum
Auxiliary Pressure Limit (with AutoBreath) ..... (16 kPa ± 10 %) maximum

Auxiliary Flow Circuit
Auxiliary Flow Range ..... 0 to 15 lpm
Auxiliary Pressure ..... (16 kPa ± 10 %) max.

AutoBreath Circuit (Factory Installed Option)
I/E Ratio ..... Fixed at 1:2 ± 20%
PEEP ..... (1.8 ± 0.4 kPa)
Breath Rate ..... 18 to 60 BPM ± 10% of setting
Adjustable Airway Pressure Relief ..... 0 to 4.9 ± 0.5 kPa
Fixed Maximum Pressure ..... (5.9 kPa ± 10%)
Oxygen Consumption ..... 50 lpm max.

RESUSCITATION (w/AutoBreath, PN 81 400 81; w/o AutoBreath, PN 81 400 73)

Wall Supply Pressure ..... 2.8 to 5.2 bar

Cylinder Pressure ..... 199.8 bar

Cylinder Diameter ..... 10 –12 cm max

Suction Circuit
Adjustable Suction Intensity ..... 0 to 20 kPa

Patient Gas Supply
Airway Pressure Limit, Operator Adjustable ..... 0 to 4.9 kPa ± 10 %
Fixed Pressure Relief, Factory Set ..... 5.0 kPa ± 20 %

Auxiliary Supply
Auxiliary Pressure Limit (w/o AutoBreath) ..... (16 kPa ± 10 %) maximum
Auxiliary Pressure Limit (with AutoBreath) ..... (4 kPa ± 10 %) maximum

Auxiliary Flow Circuit
Auxiliary Flow Range ..... 0 to 15 lpm
Auxiliary Pressure ..... (4 kPa ± 10 %) max.

AutoBreath Circuit (Factory Installed Option)
I/E Ratio ..... Fixed at 1:2 ± 20%
PEEP ..... 1.8 ± 0.4 kPa
Breath Rate ..... 18 to 60 BPM ± 10% of setting
Adjustable Airway Pressure Relief ..... 0 to 4.9 ± 0.5 kPa
Fixed Maximum Pressure ..... 5.0 kPa ± 10%
Oxygen Consumption ..... 50 lpm max.

3.2 THEORY OF OPERATION

3.2.1 GENERAL

This section contains the functional description and detailed theory of operation of the equipment. A diagram of the **Resuscitaire® Radiant Warmer** is shown in Figure 3.1.

3.2.2 OVERALL FUNCTIONAL DESCRIPTION

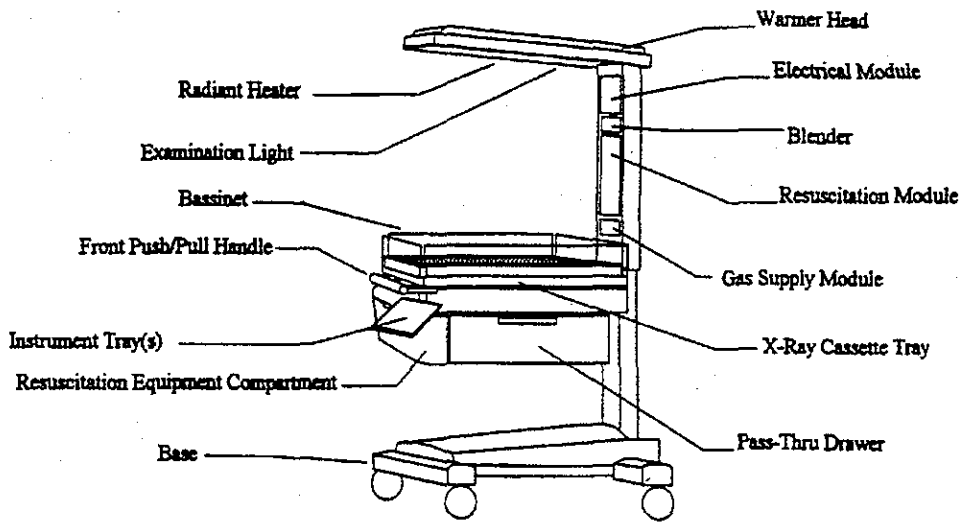


FIGURE 3.1: RESUSCITAIRE® RADIANT WARMER

Warmer Module

The Warmer is controlled by a Controller which provides **Pre-Warm** Mode, **Manual** Mode heater control, or **Baby** Mode (automatic skin temperature servo control). An Examination Light provides added illumination of the mattress area. A Warmer Head Pivot permits the Warmer to be pivoted 90° to either side for X-ray procedures. In addition, when the Warmer is pivoted, it can be powered to provide heat.

Bassinet

The Bassinet is designed to provide maximum function and utility to aid in the care of the newborn. The side and front panels may be folded down to permit maximum access to the infant. The mattress may be tilted up in the rear at a 5- or 10-degree angle. Openings are provided on each side of the Bassinet for the insertion of the optional X-ray Cassette Tray.

Controller

At power-up, the microprocessor within the Controller performs a series of power-up diagnostic tests to confirm the proper operation of the system. During this time, all displays and indicators are lighted (except **Power Fail**)and an audible tone is sounded.

When powered up, the system initializes in the Pre-Warm Mode. In the Pre-Warm Mode, the Controller will start the heater at 100% power and maintain that setting for three minutes, reduce to 60% for 12 minutes and then reduce the heater power to 30%.

When operating the Controller in the Manual Mode, the operator can adjust the heater power from 0 to full power. After 10 minutes of operation in the Manual Mode, a Chk Patient Alarm occurs. Failure to acknowledge the Chk Patient Alarm within the next 5 minutes will cause the heater to be turned *Off*.

When operated in the Baby Mode, the Controller utilizes a Skin Temperature Probe, connected between the Controller input and the infant, to automatically adjust the heater output of the Warmer Module to maintain a digitally displayed preset Set Temperature.

The Apgar Timer displays the elapsed time and sounds an audible dual tone to alert the operator that 1, 5, and 10 minutes have elapsed since the timer was activated.

The Keypad Lock Key, when pressed, renders the Up/Down Arrows and Select Mode Keys inactive or active.

A Procedural Silence Timer prevents Baby Temp audible alarms during routine procedures.

The >37 °C Key enables the Temperature Override Mode.

Pressing the °C/°F Key alternately selects between the two units of temperature measurement, used to display Baby and Set Temperature.

The operator can also turn *On/Off* the Exam light, located in the Warmer Module, using the Exam Light Key, on the Controller.

Blender Module (optional)

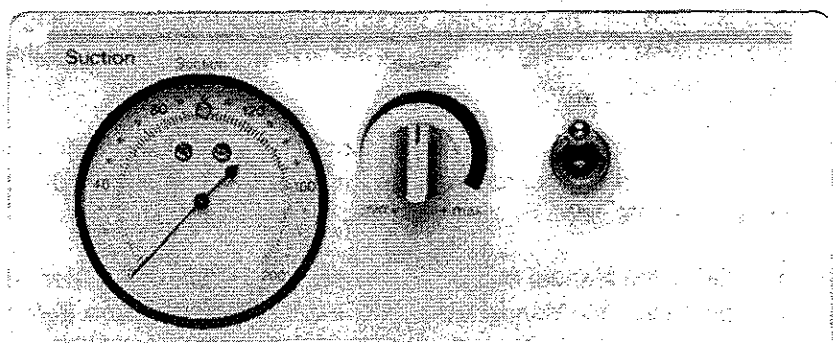
The Blender Module provides blended Oxygen from 21 to 100% to the **Patient Outlet** on the Resuscitation Module.

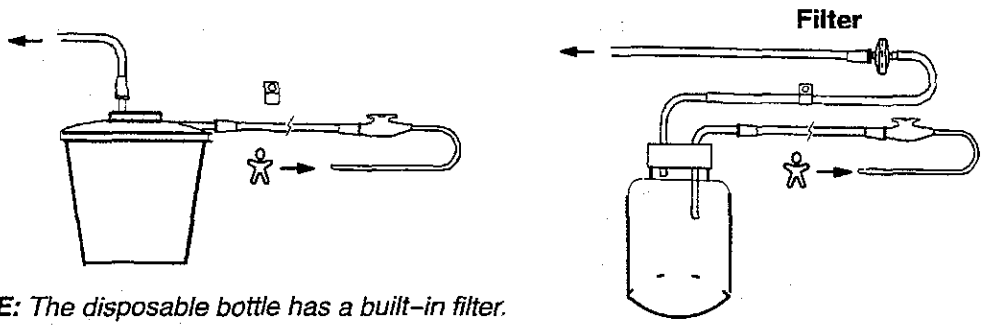
Resuscitation Module with the AutoBreath Infant Resuscitator (optional)

The Resuscitation Module contains pneumatic circuitry necessary for infant resuscitation. Controls and displays for the module are located above and to the rear of the Bassinet.

The Resuscitation Module consists of the following components:

- **Suction** – The Suction Circuit (reusable or disposable) is driven by a gas powered venturi actuated vacuum generator which provides a negative pressure (vacuum) for suctioning the patient's airway. The suction pressure is indicated on the **Suction Gauge**. Suction pressure may be adjusted using the **Suction Control** or turned *On* and *Off* using the **On/Off Switch**. A fixed internal relief valve limits the maximum suction level to −150 mmHg (19.99 kPa).





NOTE: *The disposable bottle has a built-in filter.*

FIGURE 3.2: SUCTION FUNCTIONAL BLOCK DIAGRAM

- **AutoBreath Infant Resuscitator** – The AutoBreath Infant Resuscitator Circuit is a gas-powered, time-cycled, continuous flow, pressure limited resuscitator. It has a **Rate (BPM) Control** and a fixed I/E ratio of 1:2 nominal. An **On/Off Switch** allows the timing circuit to be turned *On* and *Off* as needed. A **PEEP Control** adjusts the Positive End Expiratory Pressure in the patient circuit. The resuscitator is utilized in conjunction with the continuous gas flow provided by the Patient Supply sub-module.

WARNING: An airway pressure monitor should be used if the AutoBreath Infant Resuscitator is to be used unattended.

- **Patient Gas Supply** – The Patient Gas Supply Circuit may be used with the AutoBreath Infant Resuscitator *On* or *Off* to provide continuous gas flow to the patient. Controls are provided for Airway Pressure Relief (maximum pressure) and Flow Rate (LPM) (circuit flow delivering 100% Oxygen or blended gas). The adjustable **Airway Pressure Relief Control** is always operative.

  A fixed internal safety relief valve is provided and is always operable. This valve provides redundant maximum pressure relief at 60 cm H_2O ± 10 % cm H_2O (5.9 ± 1 kPa) and also allows the patient to inspire room air in the event of gas supply failure.

WARNING: Breathing room air through the 2-way relief valve requires extra effort. This condition, if it occurs, should be rectified as soon as possible.

- **Auxiliary Flow**– The Aux. Flow circuit supplies 100% Oxygen through the Aux. Flow (LPM) Control to the **Aux. Outlet Connector**. It is intended for Oxygen enrichment of a manual bag resuscitator, for supplemental delivery to the patient, the mother, or a second neonate, i/e., twins. The **Aux. Flow LPM Control** adjusts the flow rate from 0 to 15 lpm. An internal preset relief valve limits the Aux. Outlet pressure to 40 cm H_2O (4 kPa).

  NOTE: *Increasing back pressure may be developed as the length of Oxygen delivery circuit tubing increases and the tubing diameter decreases. Install Oxygen delivery circuit tubing as intended in a clinical situation and verify, through flow measurements, that approximately 15 LPM (maximum) can be achieved.*

- **Airway Pressure**– The Airway Pressure Gauge displays airway pressure when connected to patient circuits via external connection.

- **Patient Breathing and Supply Circuits**– The patient breathing circuit used in conjunction with the AutoBreath Infant Resuscitator is illustrated in Figure 3.4. In addition, a patient supply circuit for Manual Bagging (Figure 3.5) may also be used.

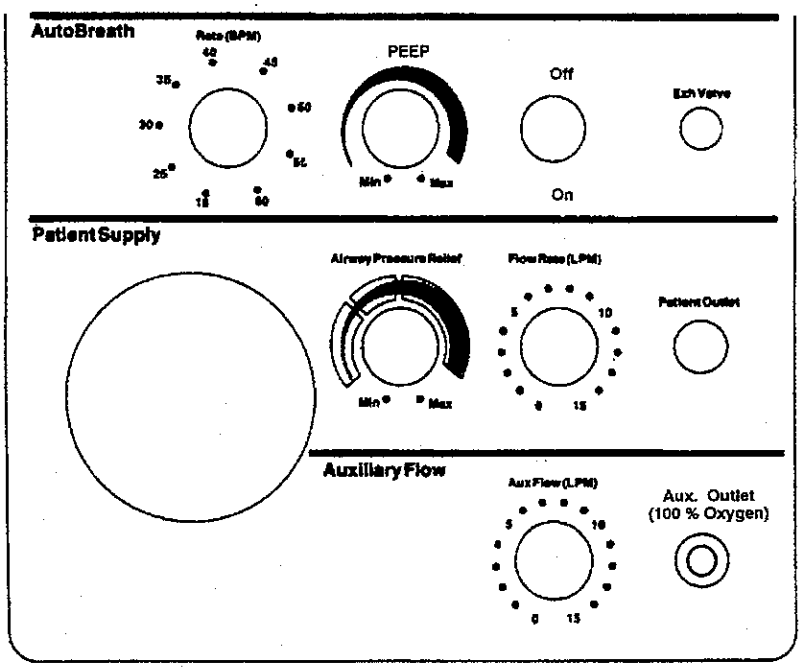


FIGURE 3.3: RESUSCITATION MODULE WITH AUTOBREATH, PATIENT GAS SUPPLY AND AUXILIARY FLOW

1-CORRUGATED TUBING
2-EXHALATION VALVE HOUSING
3-EXHALATION VALVE CAP
4-EXHALATION VALVE DIAPHRAGM
5-EXHALATION VALVE CONTROL LINE TUBING
6-EXHAUST PORT
7-PATIENT PORT

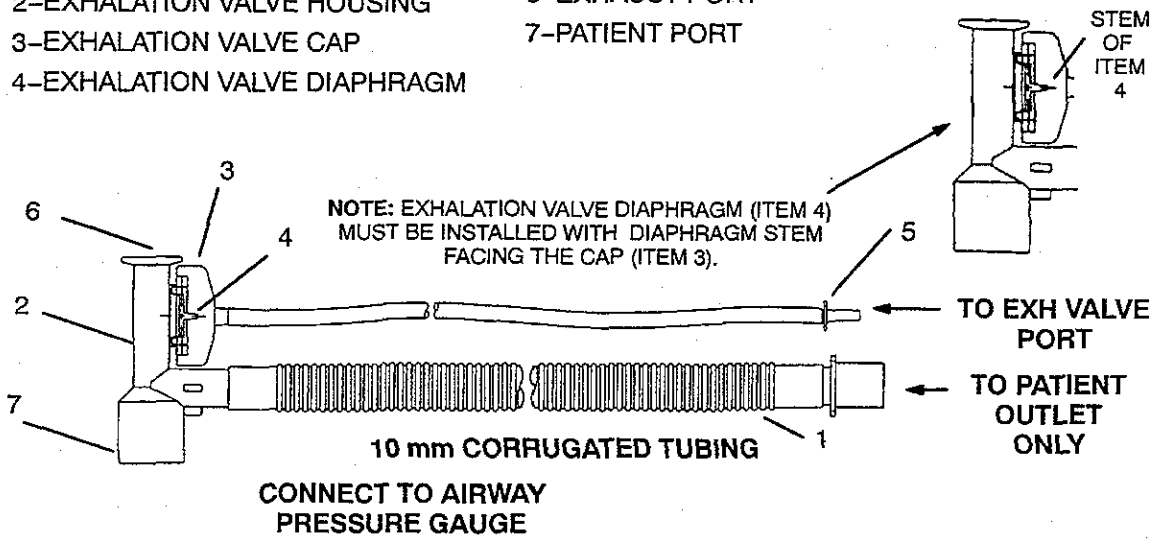


FIGURE 3.4: PATIENT BREATHING CIRCUIT FOR AUTOMATIC VENTILATION

1-10/7.5 mm ID Adapter 2-10 mm Corrugated Tubing
3-15 mm/10 mm Adapter

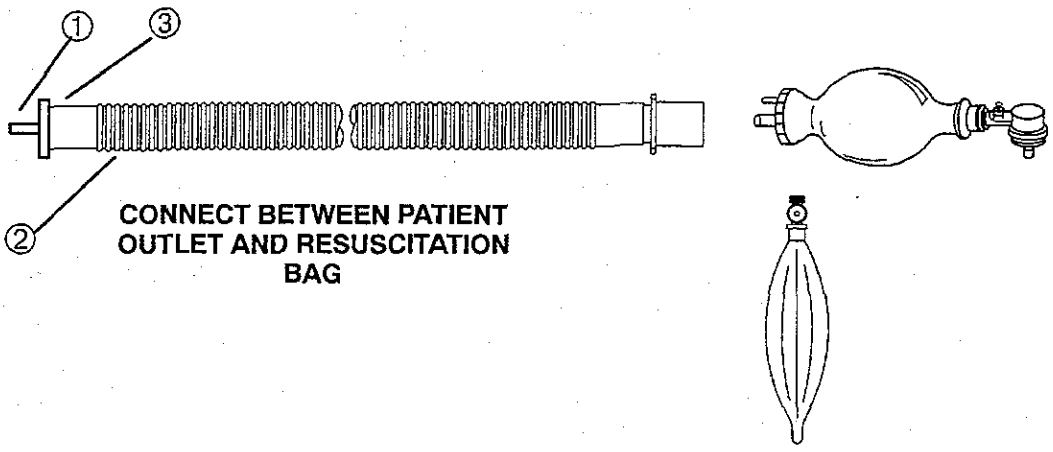


FIGURE 3.5: PATIENT BREATHING CIRCUIT FOR MANUAL VENTILATION WITH THE AUTOBREATH INFANT RESUSCITATOR

Resuscitation Module without the AutoBreath Infant Resuscitator (optional)

The Resuscitation Module contains pneumatic circuitry necessary for infant resuscitation. Controls and displays for the module are located above and to the rear of the Bassinet.

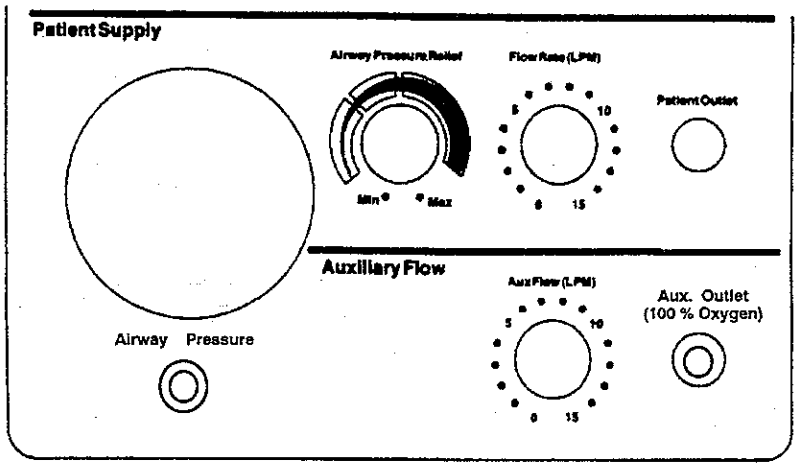


FIGURE 3.6: RESUSCITATION MODULE WITHOUT AUTOBREATH

The Resuscitation Module consists of the following components:

- **Suction** – The Suction Circuit (resusable or disposable) is driven by a gas powered venturi actuated vacuum generator which provides a negative pressure (vacuum) for suctioning the patient's airway. The suction pressure is indicated on the **Suction Gauge**. Suction pressure may be adjusted using the **Suction Control**. The suction is turned *On* and *Off* using the **On/Off Switch**. A fixed internal relief valve limits the maximum suction level to –150 mmHg (19.99 kPa). Refer to Figure 3.2.

- **Patient Gas Supply** – The Patient Gas Supply Circuit may be used to provide continuous gas flow to the patient. Controls are provided for Airway Pressure Relief (maximum pressure) and Flow Rate (LPM) (circuit flow delivering 100% Oxygen or blended gas). The adjustable **Airway Pressure Relief Control** is always operative.

  A fixed internal safety relief valve is provided and is always operable. This valve provides back–up maximum pressure relief at 60 cm H_2O ± 10 % cm H_2O (5.9 ± 1 kPa) and also allows the patient to inspire room air in the event of gas supply failure.

WARNING: Breathing room air through the 2–way relief valve requires extra effort. This condition, if it occurs, should be rectified as soon as possible.

- **Auxiliary Flow**– The Aux Flow circuit supplies 100% Oxygen through the **Aux Flow** (LPM) **Control** to the **Aux Outlet Connector**. It is intended for Oxygen enrichment of a manual bag resuscitator, for supplemental delivery to the patient, the mother, or a second neonate, i/e., twins. The **Aux Flow** (LPM)**Control** adjusts the flow rate from 0 to 15 lpm. An internal preset relief valve limits the Aux Outlet pressure to 160 cm H_2O (16 kPa).

  NOTE: *Increasing back pressure may be developed as the length of Oxygen delivery circuit tubing increases and the tubing diameter decreases. Install Oxygen delivery circuit tubing as intended in a clinical situation and verify, through flow measurements, that approximately 15 LPM (maximum) can be achieved.*

- **Airway Pressure**– The Airway Pressure Gauge displays airway pressure when connected to patient circuits via external connection.

- **Patient Breathing and Supply Circuits**– The patient breathing circuit used in conjunction with the Resuscitation Module, without the AutoBreath Infant Resuscitator, is illustrated in Figure 3.7. In addition, a patient supply circuit for Manual Bagging (Figure 3.5) may also be used.

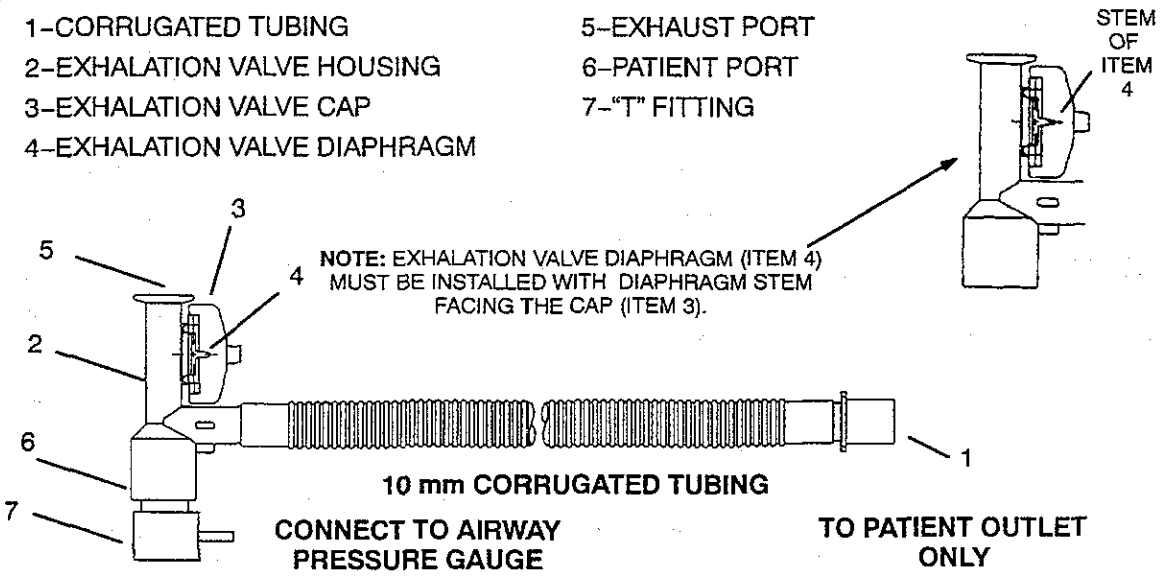

1-CORRUGATED TUBING
2-EXHALATION VALVE HOUSING
3-EXHALATION VALVE CAP
4-EXHALATION VALVE DIAPHRAGM
5-EXHAUST PORT
6-PATIENT PORT
7-"T" FITTING
STEM OF ITEM 4
NOTE: EXHALATION VALVE DIAPHRAGM (ITEM 4) MUST BE INSTALLED WITH DIAPHRAGM STEM FACING THE CAP (ITEM 3).
10 mm CORRUGATED TUBING
CONNECT TO AIRWAY PRESSURE GAUGE
TO PATIENT OUTLET ONLY

FIGURE 3.7: PATIENT BREATHING CIRCUIT FOR MANUAL VENTILATION WITHOUT THE AUTOBREATH INFANT RESUSCITATOR

Gas Supply

The Gas Supply Module consists of an **Oxygen Cylinder Pressure Gauge** and/or an **Air Cylinder Pressure Gauge** and a **Gas Supply On/Off Switch** which controls the gas supply to the entire pneumatic system.

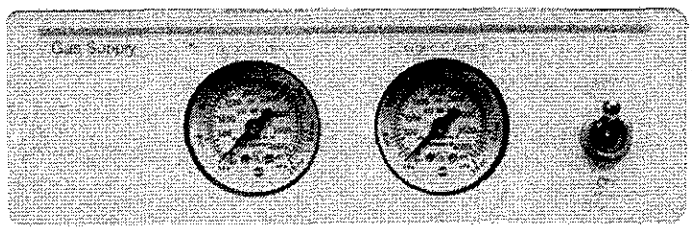


FIGURE 3.8: GAS SUPPLY

Alarms

HIGH TEMPERATURE. When the Skin Temperature Probe is attached to the infant and the skin temperature exceeds 39.0 °C, the heater is automatically turned *Off*, the **High Temp Indicator** will flash and the audible alarm will sound continuously. Press the **Silence/Reset Key** to silence the alarm for two minutes. After the alarm condition is corrected (a skin temperature of 38.5 °C or less), the alarm will automatically reset. If the Skin Probe should detect a temperature of 39.5 °C, a hardware shutdown will occur and a System Fail alarm will be generated.

CHECK PATIENT. When in the Manual Mode, after 10 minutes of operation, the **Chk Patient Indicator** will remain illuminated and the audible alarm will sound every 30 seconds for 5 minutes. If the alarm has not been acknowledged at the end of 5 minutes, the heater will be shut down and a continuous ramping audible alarm will sound. The **Silence/Reset Key** then must be pressed to reactivate the heater.

PROBE. If the Skin Temperature Probe fails (short-circuited or open-circuited) or if the Controller is in the Baby Mode and there is not a Skin Probe connected to the Controller, the **Probe Indicator** will flash and a ramping audible alarm will sound. After the alarm condition is corrected (the Probe is replaced), the alarm will automatically reset.

BABY TEMP. When the temperature sensed by the Skin Temperature Probe is 1 °C above or 1 °C below the selected Set Temperature Display setting (in the Baby Mode), the **Baby Temp Indicator** will flash and an audible alarm will sound, first at a low level, then at a medium level, then at a high level. In addition, if the temperature is 0.2 °C above the selected **Set Temperature,** the heater will be turned *Off* automatically. Press **Silence/Reset** to silence the alarm for 10 minutes.

POWER FAIL. When power to the unit is interrupted while the Controller is *On*, the **Power Fail Indicator** will flash and the audible alarm will beep. When power is restored to the unit, the alarm will automatically reset and all of the settings will be retained. The alarm may be silenced by turning *Off* the Power Switch.

IMPORTANT: *Turning Off the Power switch will prevent the Controller and Heater from restarting automatically when power is returned to the unit. The settings will be retained in memory until power is restored.*

SYSTEM FAIL. If an internal malfunction is detected, the **System Fail Indicator** will flash and the audible alarm will beep. In addition, an Error Code (eR00 to eR25) will be displayed in the Baby Temperature Display (refer to Table 5.1). This alarm is not resettable. A prolonged brown-out (five minutes or more) will also cause a System Fail alarm.

BLENDER DIFFERENTIAL BYPASS ALARM. The Blender Module will alarm and bypass whenever the pressure differential between the O_2 and Air supplies exceeds 30 psi ± 5 psi . When this condition occurs, the blender will continue to supply whichever gas is at the higher pressure: either 100% Air or 100% Oxygen. This is an audible alarm only. There are no visual indicators.

Apgar Timer

When the **Apgar Timer** is running, the Apgar Timer Display will show elapsed minutes and seconds and the audible alarm will sound at the 1-, 5- and 10-minute Apgar time intervals.

3.3 DETAILED CIRCUIT DESCRIPTION

3.3.1 DISPLAY PCB1

Display PCB1 contains all of the Front Panel Switches, Display Driver and Displays. In addition, it contains the Dual Analog Probe Circuitry and an A/D Converter. There are also two precision reference power supplies: one for the adjustable 5.0 Vdc and a fixed –2.5 Vdc reference.

There are three pots on PCB1 that require adjusting: the 5.0 V precision reference potentiometer, R15, and the Dual Probe Amplifier Calibrations potentiometers, R13 (Channel 1) and R28 (Channel 2). The Probe Amplifier circuits are calibrated at 36.0 °C. Dual precision calibration resistors are provided on PCB1.

The imbedded Off–Line Diagnostic Test Software enables the user to completely test PCB1 and PCB2. The Diagnostic Test Mode is entered from the Front Panel Display during reset or start–up of the Unit. The test results are displayed on the Front Panel Displays.

3.3.2 POWER AND CONTROL PCB2

The Control PCB contains the circuitry required to control the heater as well as the operator interface. The Control PCB supports three operating modes: Pre–Warm, Manual and Baby. The enhanced Controller provides all three modes of operation, while the standard Controller only provides the Pre–Warm and Manual Modes of operation.

In addition, the Control PCB contains the circuitry required to control the Remote Isolated Serial Port. The nine pin connector, located at the rear of the unit, provides the hardware interface which can be used with a standard serial printer. When a serial printer is connected to this port, the user can obtain a hard copy of error messages related to System failures.

3.3.3 POWER SUPPLY CIRCUIT

D.C. Power Supply

The DC Power Supply supplies ±12 Vdc, +5 Vdc and ground to PCB2, via connector J2.

Circuit Breaker

The circuit breaker, CB1, is not located on the Power and Control PCB. It is located at the rear of the Unit on the Electrical Module. The breaker has a rating of 12.0 A for 100–120 Vac operation and 6.0 A for 220–240 Vac operation. The circuit breaker turns the unit *On/Off* when switched by the operator. It also shuts the Unit *Off* in the presence of excessive current drain.

Fuses

The fuses, F1 and F2, are located on the Power and Control PCB. They are rated at .5 A for 230 Vac operation and 1.0 A for 100 and 120 Vac operation.

Isolation Transformer

AC power is brought into PCB2 via connector J6 and then directly to the primaries of isolation transformer, T2.

Logic Power

The +5 Vdc Voltage is supplied via the DC Power Supply, located on the Electrical Module. It is brought into PCB2 via connector J2 and PCB1 via connector J1.

The +12 Vdc Voltage is supplied via the DC Power Supply, located on the Electrical Module. It is brought into PCB2 via connector J2 and PCB1 via connector J1.

The –12 Vdc Voltage is supplied via the DC Power Supply, located on the Electrical Module. It is brought into PCB2 via connector J2 and PCB1 via connector J1.

The +5 VREF signal is supplied via the +12 Vdc signal in conjunction with the regulator, U5, capacitors C12 and C13, resistor, R10, and the fine tuning potentiometer, R15.

3.3.4 CONTROL CIRCUITRY

Microcontroller

The core processing unit of the controlling circuitry is the Motorola MC68HC11ABFN microcontroller. The microcontroller is located on PCB2.

The frequency is 8 MHz.

The internal and external address bus is 16 bits; the internal and external data bus is 8 bits.

Display Drivers

The Display Drivers are located on PCB1: U1, U2, U3 and U10 (for the enhanced Set Temperature Mode, only; refer to Figure 7.1).

Sound Generator

Sound is generated by U5 and U4 together. They are located on PCB2 and are used to generate the System alarm sounds.

A/D Converter

The external A/D converter, U4, is located on PCB1. It interfaces and is controlled directly by the serial peripheral interface of the microcontroller.

The A/D converter reads the probe channels, probe calibration and ambient temperature.

3.3.5 SYSTEM INTERFACES

Baby (Skin) Temperature Probe

The Baby Temperature Probe signals are brought to PCB2 via connector J3. The signals SK1 and SK2 are brought to PCB1 via connector J1 and converted to a digital signal via the A/D Converter, U4.

Ambient Temperature Probe

The Ambient Temperature Probe signal, PROBEC, is brought to PCB1 via connector J1 and converted to a digital signal via the A/D Converter, U4.

Data Port

The Data Port signals are brought to PCB2 via connector J5. The signals present at this port are electrically isolated from the remaining circuitry via Isolation Transformer, T1.

This Data Port supports a printer interface protocol.

The Baud Rate is at 2400 Baud.

3.3.6 SYSTEM FAIL LOGIC

The System Fail Logic produces a System Failure Alarm when the following conditions occur: high baby temperature detected (>39.5 °C), microcontroller system failure detected by the watchdog timer, skin temperature dual thermistor probe differential of > ± 0.4) or a system failure is detected which prevents proper operation of the system (e.g., heater failure).

The System Fail Alarm is not self–resetting.

The Watchdog Timer Circuitry resides on PCB2.

3.3.7 POWER FAIL LOGIC

The Power Fail Logic produces a Power Fail Alarm when the following conditions occur: loss of ac mains supply, emergency ac mains switch *Off* or power cord disconnection. If ac power fails, the alarm is powered by capacitor, C29.

The Power Fail Alarm is self–resetting with the resumption of power.

The Power Fail Circuitry resides on PCB2.

3.3.8 PNEUMATIC SYSTEM

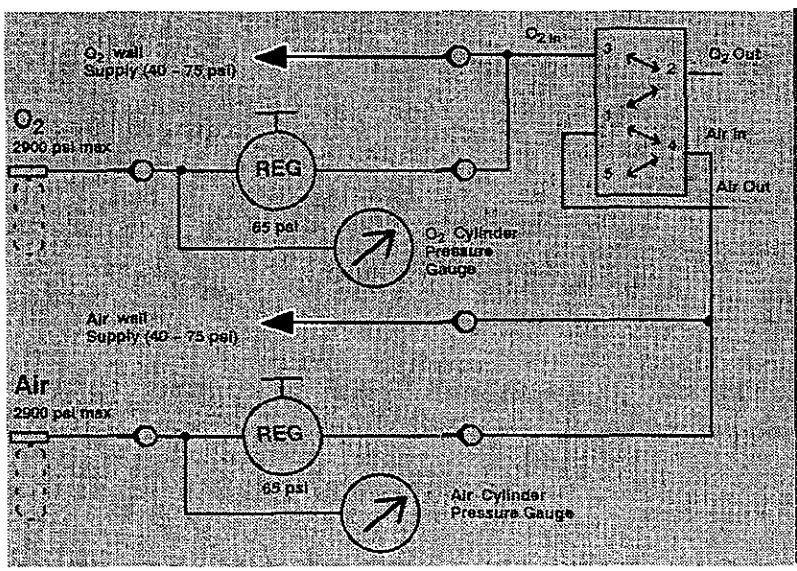
The Pneumatic System consists of three modules (Gas Supply, Resuscitation and Blender), a patient breathing circuit, and a suction collection bottle.

The Gas Supply Module connects the pipeline and/or cylinder supplied gas to the Pneumatic System. The Resuscitation Module contains the suction, Oxygen delivery, and an optional ventilator circuitry. An optional Precision Blender Module mixes the Oxygen and Air supplies. The Patient Breathing Circuit completes the system by connecting the Resuscitation Module to the patient.

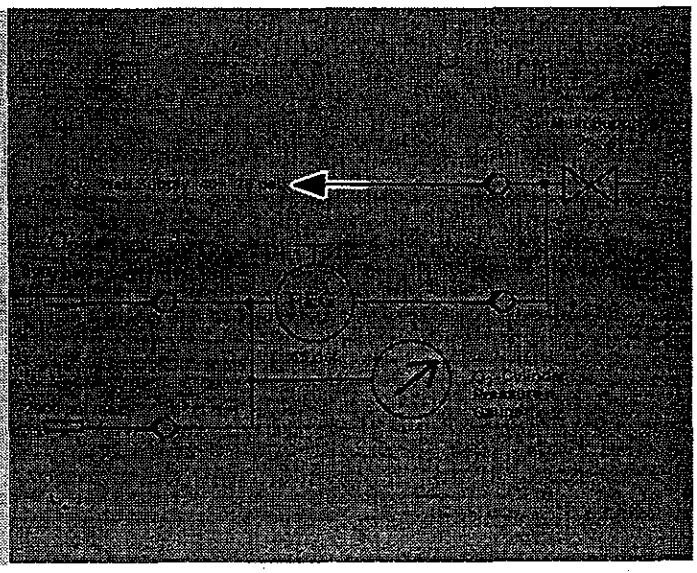
GAS SUPPLY MODULE

The Gas Supply Module consists of two basic variants which share common components. The two basic variants are as follows: 1) O_2 Pipeline (With Cylinder Supply) and 2) O_2/Air Pipeline (With Cylinder Supply).

O_2/Air Pipeline, With Cylinder Supply



O_2 Pipeline, With Cylinder Supply



Main Switch

The Main Switch is a toggle actuated *On/Off* valve which enables the user to turn *On/Off* all supply gases with a single control.

Reserve Gas Supply

The regulator is preset at 65 psi when the cylinder pressure is 1200 psig. Output varies with the input pressure.

Cylinder Pressure Gauges

Each cylinder gas circuit contains a pressure gauge which enables the user to monitor the cylinder pressure.

RESUSCITATION MODULE

The Resuscitation Module is an integrated package that contains several pneumatic circuits for infant resuscitation.

The Module uses flow control valves to control many of the module parameters: Suction Control, PEEP, Airway Pressure Relief, Flow Rate and Aux. Flow Rate. All of these valves are single-turn, calibrated-dial or magnitude adjustment type valves with stops at both the maximum and minimum extremes. The flow controls are calibrated by the vendor. The knob, on the shaft of the flow control, is intentionally set so that when the flow is adjusted to its minimum flow position, there is a small bleed flow through the valve. This prevents the valve seat from being damaged and the flow characteristics from changing.

CAUTION: If the knob is removed, the unit must be recalibrated.

Patient Supply

The Patient Outlet provides 0 to 15 lpm with an adjustable airway pressure relief from 0 to 50 cm H_2O and a factory-set safety relief valve at 50 cm H_2O for Units equipped with the older Resuscitation Module (with and without the AutoBreath Resuscitator), PN 81 400 80 and 81 400 72, respectively.

The Patient Outlet provides 0 to 15 lpm with an adjustable airway pressure relief from 0 to 50 cm H_2O and a factory-set safety relief valve at 60 cm H_2O for Units equipped with the new Resuscitation Module (with and without the AutoBreath Resuscitator), PN 81 400 81 and 81 400 73, respectively.

The flow rate is controlled by a calibrated dial type flow adjustment. When the Blender Module is included in the system, the Patient Outlet provides the O_2/Air mixture selected by the operator. The Adjustable Airway Pressure Control consists of a flow control valve which controls the gas flow through a pressure divider. This controls the pressure applied to a diaphragm which occludes a seat in the pressure relief valve assembly. By varying this pressure, the Airway Pressure Relief threshold can be adjusted.

Auxiliary Supply

The Aux. Outlet provides from 0 to 15 lpm of 100% Oxygen (with a factory set internal safety relief valve at 40 cm H_2O for Units equipped with the older Resuscitation Module with the Autobreath Resuscitator, PN 81 400 80).

The Aux. Outlet provides from 0 to 15 lpm of 100% Oxygen (with a factory set internal safety relief valve at 160 cm H_2O for Units equipped with the older Resuscitation Module without the AutoBreath Resuscitator, PN 81 400 72).

The Aux. Outlet provides from 0 to 15 lpm of 100% Oxygen (with a factory set internal safety relief valve at 160 cm H_2O for Units equipped with the new Resuscitation Module with and without the AutoBreath Resuscitator, PN 81 400 81 and 81 400 72, respectively).

Airway Pressure Gauge

The Airway Pressure Gauge is used to Monitor the patient's airway pressure. For units equipped with the AutoBreath Infant Resuscitator, the airway pressure reading can be obtained from either the Patient Outlet or the Aux. Outlet. However the reading is affected by the patient flow and airway pressure relief adjustments. For units not equipped with the AutoBreath Infant Resuscitator, the airway pressure readings are obtained from the Gauge Port and are isolated from the patient supply pneumatic circuitry.

Suction

The Suction circuit uses an Oxygen driven venturi to generate from 0 to 150 mmHg suction at 5 lpm nominal for Units equipped with the older Resuscitation Module with and without the Autobreath Resuscitator, PN 81 400 80 and 81 400 72, respectively.

The circuit generates from 0 to 150 mmHg suction at 19 lpm free air flow through a 6 mm ID x 5' lg tubing @ max. suction intensity of –150 mmHg (19.99 kPa) for Units equipped with the new Resuscitation Module with and without the AutoBreath Resuscitator, PN 81 400 81 and 81 400 73, respectively.

The suction gauge displays the generated suction magnitude. This value varies with the flow supplied to the venturi assembly and the resistance in the suction supply and patient connection circuits.

AutoBreath Infant Resuscitator (optional)

The AutoBreath Infant Resuscitator circuit is a basic gas–powered, time cycled, continuous flow, pressure limited resuscitator. The AutoBreath Infant Resuscitator circuit, used in combination with the Patient Breathing Circuit, provides automatic continuous flow ventilation. The automatic ventilation is driven by a pneumatic oscillator which pressurizes and bleeds the exhalation chamber of the exhalation valve. The diaphragm in this chamber controls patient inspiration and expiration. The frequency of the oscillator is controlled by the Breath Rate flow control valve which is user adjustable from 18 to 60 BPM (Breaths Per Minute). Throughout this range, a constant inspiratory to expiratory phase time ratio of 1:2 nominal is automatically maintained. In addition to frequency control, the operator can adjust the PEEP (Positive End Expiratory Pressure) from 0 to 18 cmH_2O. This circuit provides PEEP by allowing the pressure applied to the control diaphragm in the exhalation valve to maintain pressure in the patient circuit during the expiratory phase. Refer to Figure 3.3.

BLENDER MODULE (Optional)

The low flow, precision blender supplies 0 to 15 lpm of an Air–Oxygen mixture, ranging from 100% Air (21% O_2) to 100% O_2 (0% Air) with blender inlet pressures of 40 to 110 psig (for both Oxygen and Air), a nominal pressure drop of less than 3 psi (at 50 psig inlet pressure and 10 lpm flow rate) and a bleed to atmosphere of 3 lpm.

The Blender will alarm and bypass whenever the Air or Oxygen gas source pressure is reduced or increased creating a pressure differential of 30 psi. This condition alters the FiO_2 and flow output from the Microblender. When this condition occurs, the Blender will continue to supply whichever gas is at the higher pressure: either 100% Air or 100% O_2.

3.3.9 WARMER HEAD

The Warmer Head contains the quartz heating element and an examination light. It is mounted to the top of the Upper Column. The Warmer Head pivots to either side of the Warmer to provide access for a portable X–ray machine. There is no latch required to move the Warmer Head. An applied force of approximately 10 pounds is all that is required to overcome the detents of the Warmer Head pivot.

HEATING ELEMENT

The Radiant Heater consists of a 600 Watt quartz tube heater.

EXAMINATION LIGHT

The Examination Light is mounted underneath the Warmer Head. It is located on the centerline of the Warmer Head directly behind the radiant heating element. The Examination light is a 50 Watt fixed–focus halogen bulb and is turned *On/Off* by a key on the front of the Electrical Module.

SECTION 4
PREVENTIVE MAINTENANCE

4.1 GENERAL

This Section provides cleaning and maintenance instructions. Where necessary, disassembly instruction are provided.

WARNING:

If Oxygen is in use, make sure that the Oxygen supply to the equipment is turned *Off* and that it is disconnected from the Oxygen supply when performing cleaning and maintenance procedures. A fire and explosion hazard exists when performing cleaning and/or maintenance procedures in an Oxygen-enriched environment.

An electrical shock hazard exists when performing cleaning and maintenance procedures; make sure that the Power Cord is disconnected from the wall receptacle.

4.2 MAINTENANCE

OPERATIONAL CHECKOUT

Before each use, the **Resuscitaire® Radiant Warmer** should be checked for proper operation. If the **Resuscitaire® Radiant Warmer** is found to malfunction, it should not be used. Refer to the Operational Checkout Procedure provided in Section 2.

4.3 CLEANING

When an infant is discharged, or at least once a week, the equipment should be thoroughly cleaned and disinfected. Cleaning can most effectively be accomplished by disassembling, then grouping the parts and/or assemblies in categories according to the method of cleaning required.

4.3.1 DISASSEMBLY FOR CLEANING

1. Remove both Bassinet Side Panels (Figure 4.1) by pulling them straight up.

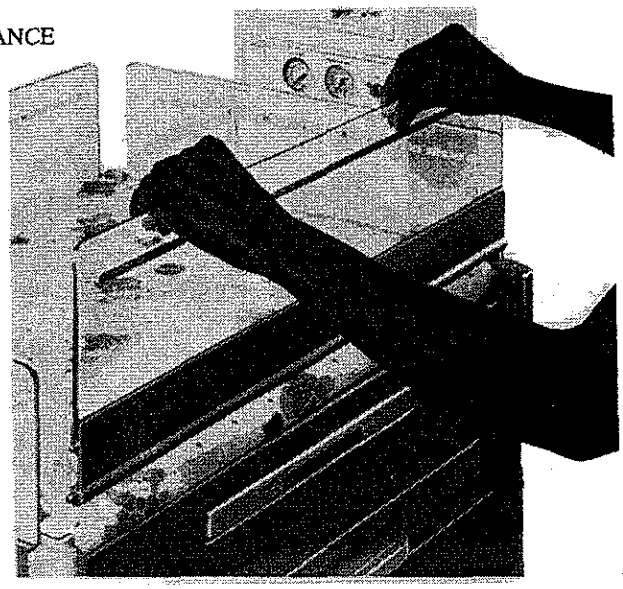


FIGURE 4.1: REMOVING BASSINET SIDE PANELS

2. Remove the Bassinet Back Panel (Figure 4.2) by raising it straight up until the bottom pins are adjacent to the slots in the corner brackets.

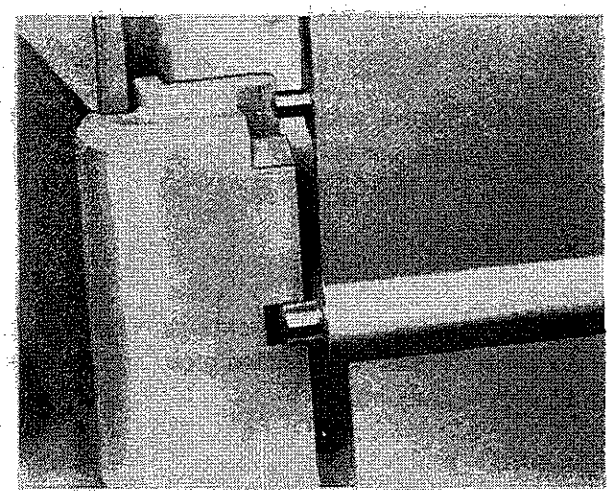


FIGURE 4.2: REMOVING BASSINET BACK PANEL

3. Remove the Bassinet Front Panel (Figure 4.4) by raising it and then swiveling it down. At the corners, press up on the release buttons and pull the panel straight out (Figure 4.3).

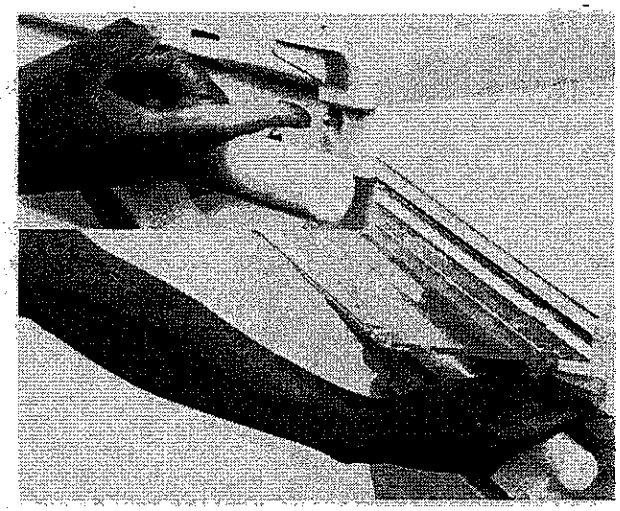


FIGURE 4.3: BASSINET FRONT PANEL RELEASE BUTTONS

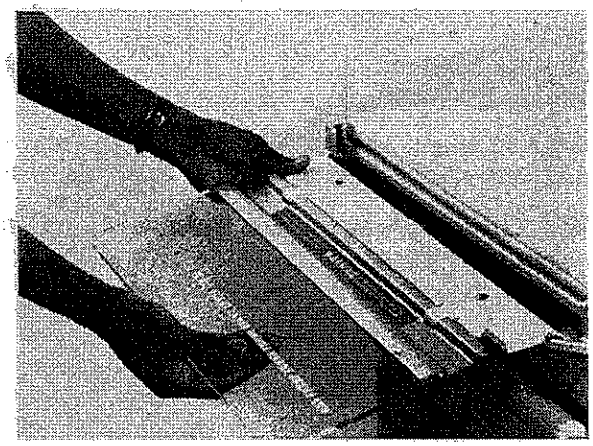


FIGURE 4.4: REMOVING THE BASSINET FRONT PANEL

4. Remove the Mattress from the Bassinet.
5. Remove the X–Ray Cassette Tray (refer to Figure 2.8).
6. Remove the Suction Bottle and Filter from the front of the Bassinet (refer to Figure 2.10).

4.3.2 CLEANING PROCEDURES

When an infant is discharged, or at least once a week, the equipment should be thoroughly cleaned and disinfected.

CLEANING AGENTS

An intermediate-level detergent/disinfectant registered by the U.S. Environmental Protection Agency should be used, but only when the equipment is not in use and disassembled as described elsewhere in this section. When using any cleaning agent, follow the manufacturer's directions for use. Before cleaning, remove all solid wastes and contaminants from the disassembled parts.

PAINTED SURFACES

- Use a detergent/disinfectant to clean all surfaces thoroughly; then dry with a clean cloth or paper towel.

CLEAR PLASTIC AND ACRYLIC SURFACES

CAUTION:

- **Alcohol can cause crazing of plastic and acrylic. Do not use alcohol, acetone, or any organic solvents for cleaning.**
- **Do not expose plastic and acrylic to direct radiation from germicidal lamps. Ultraviolet radiation from these sources can cause cracking and crazing of clear plastic and acrylic.**

- Use a detergent/disinfectant to clean all surfaces thoroughly. Make sure to clean all holes, indentations, baffles, etc.; then dry with a clean cloth or paper towel.

METAL SURFACES

- Use a detergent/disinfectant to thoroughly clean all surfaces; then dry with a clean cloth or paper towel.

SKIN TEMPERATURE PROBE, REUSABLE

CAUTION: Do not pull on the tip of the skin temperature probe when cleaning or drying; damage to the probe may result.

- Use a detergent/disinfectant to thoroughly clean all surfaces; then dry with a clean soft cloth or paper towel.

IMPORTANT: *After cleaning, a complete operational checkout should be performed before returning the unit to service.*

4.4 STERILIZATION (IF DESIRED)

CAUTION: DO NOT STEAM AUTOCLAVE.

Sterilization can be accomplished by the following methods:

A. COLD (LIQUID) STERILIZATION

CAUTION: Do not expose plastic and acrylic to direct radiation from germicidal lamps. Ultraviolet radiation from these sources can cause cracking of gasket surfaces, fading of paint, and ultimately, crazing of plastic and acrylic.

B. GAS STERILIZATION (ETHYLENE OXIDE). Prior to gas sterilization, the entire unit should be thoroughly cleaned as described elsewhere in this section. Remove and discard all used disposable elements. New disposable elements should be installed after sterilization.

Standard gas sterilization procedures are satisfactory as these do not normally exceed 54.4 °C (130 °F).

IMPORTANT: *After sterilization, a complete functional checkout procedure should be performed before returning the unit to service.*

4.5 REASSEMBLY AFTER CLEANING

1. Replace the Mattress on the Bassinet.
2. Replace the X-Ray Cassette Tray.
3. Replace the Bassinet Back Panel by inserting the pins in the Corner Brackets.
4. Replace the Bassinet Side Panels by pushing them straight down into their slots.
5. Replace the Bassinet Front Panel by sliding it into the Front of the Bassinet until the release tabs catch. Raise the Panel into position.
6. Install a new Suction Filter if a Reusable Bottle is in use. Replace the Suction Bottle if a DIsposable Suction Bottle is in use.

4.6 CALIBRATION

The equipment should be completely checked and calibrated prior to initial use and at least annually thereafter in accordance with the procedures in Section 5.

4.7 TROUBLESHOOTING

Troubleshooting for the equipment is presented in Section 5 of this Service Manual. Also refer to the schematics in Section 7.

Change 5

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SECTION 5
SERVICE

5.1 GENERAL

This Section provides the following service information for the **Resuscitaire® Radiant Warmer**: 1) DC Power Requirements, 2) Leakage Current Test, 3) Heater Head Electrical Requirements, 4) Pneumatic System Checkout, 5) Troubleshooting Guidelines and 6) Removal and Replacement Procedures.

5.2 ADJUSTMENTS AND CALIBRATION

5.2.1 ADJUSTMENTS

PRECISION 5-VOLT REFERENCE ADJUSTMENT

Equipment Required

- DC (Fluke 8080A or equivalent)
- Small Screwdriver (or Trim Pot Adjustment Tool)

Procedure (refer to Paragraph 5.9)

1. Perform Off-Line Diagnostic Test #12.
2. Place the leads of the DVM across pin 11 (Gnd) and pin 37 (Voltage Out) of connector J1.
3. Adjust the precision 5V reference resistor R15, on the Display Board, until the value on the DVM reads 5V ± 10 mV.

SKIN PROBE 1 TEMPERATURE SENSOR ADJUSTMENT

Equipment Required

- Small Screwdriver (or Trim Pot Adjustment Tool)

Procedure (refer to Paragraph 5.9)

1. Perform Off-Line Diagnostic Test #12.
2. On the Display Board, adjust R13 of the Channel 1 temperature sensor circuit until the value displayed on the Baby Mode Temperature Display reads 36.00 °C ± .10.

SKIN PROBE 2 TEMPERATURE SENSOR ADJUSTMENT

Equipment Required

- Small Screwdriver (or Trim Pot Adjustment Tool)

Procedure (refer to Paragraph 5.9)

1. Perform Off-Line Diagnostic Test #12.
2. On the Display Board, adjust R28 of the Channel 2 temperature sensor circuit until the value displayed on the Apgar Timer Display reads 36.00 °C ± .10.

Change 1

HEATER VOLTAGE SENSE ADJUSTMENT

Equipment Required

- DVM (Fluke 8080A or equivalent)
- Small Screwdriver (or Trim Pot Adjustment Tool)

Procedure (refer to Paragraph 5.9)

1. Perform Off-Line Diagnostic Test #6.
2. Use a Digital Voltmeter (DVM) to measure the Input AC Line Voltage on the Control Board.
3. Adjust R9 until the value shown on the Baby Temperature Display equals the measured value on the DVM.

5.2.2 RESUSCITATION CALIBRATION

To be supplied.

5.3 DC POWER REQUIREMENTS

Equipment Required

- DVM (Fluke 8080A or equivalent)

At the specified ac input voltage, verify the following dc voltages on the Controller Board. Refer to Figure 7.2.

DC OUTPUT VOLTAGE	CONNECTOR,PIN
+5.2 V ± .05 V	J2-2 or J2-3
+12 V ± .50 V	J2-1
-12V ± .50 V	J2-6
GND	J2-4

5.4 LEAKAGE CURRENT TEST

Equipment Required

- Leakage Tester

TEST SET-UP

1. Connect the Controller to the primary power source through an ungrounded adapter plug so that the unit is ungrounded. Turn the power switch *On*.
2. The leakage current test standards, provided in the test procedures below, assume leakage through a resistance of 1000 Ohms. If the Leakage Tester being used does not provide this resistance, the test set-up must be adjusted to provide it.
3. Perform the above steps (1 and 2) with the Controller power switch *Off*.

TEST PROCEDURES

1. Use the Leakage Current Tester to measure between the chassis of the unit under test and a known ground such as the ground connection of a wall receptacle. The leakage current must not exceed 300 uA for 100/120 Vac Units or 500 uA for 220/240 Vac Units.

   NOTE: *220/240 V Units must be tested at 264 V in accordance to the recommended standards.*

2. Reverse the plug and repeat the previous step.

5.5 HEATER HEAD ELECTRICAL REQUIREMENTS

Equipment Required

- DVM
- Leakage Current Detector

1. Verify that the heater installed matches the Assembly Name Plate Data:

	HEATER VOLTAGE	HEATER COLD RESISTANCE
100 Volt Unit	100 Volt Heater	12 to 15Ω
120 Volt Unit	120 Volt Heater	17 to 21Ω
220 Volt Unit	220 Volt Heater	59 to 69Ω

2. At the specified ac input voltage, verify that the heater illuminates.
3. Verify that the ac leakage current is ≤ 40 uA.

5.6 PNEUMATIC SYSTEM CHECKOUT

Equipment Required

- Oxygen Analyzer - Bio-Tek 74233 (or equivalent)
- Wilkerson Regulator - Part Number 67 352 36
- Nipple DISS, O2- Part Number 67 355 10
- Nipple Regulator to DISS "T" Piece- Part Number 67 356 02
- 15 mm Adapter - Part Number 67 352 11
- 15 mm Female Adapter - Part Number 67 352 10
- 13-inch Black Corrugated Hose - Part Number 67 362 00
- Green PVC Tubing 15 inches Long (Qty. 3) - Part Number 67 359 01
- Brass Elbow - Part Number 67 355 44

5.6.1 SYSTEM OVERVIEW

1. Perform a visual inspection of the System (checking for marks, scratches, etc.).
2. Make sure that all of the Control Knobs turn smoothly.
3. Make sure that all of the gauges read zero (±1 Unit/Measurement) when the System is *Off*.
4. Remove the Back Cover and inspect for the following:
   a) loose tubes
   b) pinched tubes
   c) improper seating of Modules

5.6.2 SYSTEM LEAKAGE TEST

With the following conditions met, make sure that the drop on the pressure gauges is less than 50 psi in 5 minutes.

- the Gas Supply Switch turned *On* and the System pressurized with Oxygen between 35 psi and 75 psi; then the Gas Supply Switch turned *Off*.
- the Patient and Auxiliary Outlets blocked.

Change 6

5.7 PNEUMATICS CHECKOUT

GAS MODULE/TANK YOKES (if equipped with reserve gas supply)

A. With Gas Supply toggle in OFF position, securely fasten tanks to cylinder connections.

B. Slowly open tanks and verify there are no leaks in the Gas Supply Module and the gauges display tank pressure.

C. Switch the Gas Supply toggle to ON position and verify there are no leaks throughout the pneumatics system, except for the normal bleed from the Blender and Patient/Aux. Outlet. Briefly operate the Resuscitation Module and verify tank gases are delivered to system with no blender alarm.

D. Close the tank valves and let Air/O_2 bleed from the Resuscitation Module. Switch the Gas Supply toggle switch to OFF position and remove tanks from cylinder connections.

PIPELINE SUPPLY/BLENDER (if equipped with Blender)

A. Connect 50 psi to air fitting. Connect the oxygen hose to the Wilkerson Regulator. Connect the regulator to the oxygen fitting. Connect the O_2 supply to the O_2 hose. Set the regulator to 50 psi. Set the Blender to 60%. Switch the Gas Supply toggle to ON position and verify there are no leaks throughout the pneumatics system, except for normal bleed from Blender and the Patient/Aux. Outlet.

B. Slowly reduce the oxygen regulator of the 50 psi supply until the Blender pressure differential alarm sounds. Verify the alarm sounds when the oxygen supply pressure is 30 ± 5 psi below air supply pressure. Adjust oxygen supply back to 50 psi and verify alarm ceases.

5.8 RESUSCITATION MODULE PERFORMANCE

O_2 CONCENTRATION

NOTE: *This test is for Systems equipped with a Blender Module. Connect the Oxygen Analyzer to the* ***Patient Outlet.***

A. Verify that the O_2 Concentration Level, at the Patient Outlet, is 60%, when the Blender Control is set to 60%.

B. Verify that the output mixture range of the Blender Module is adjustable, with the Blender Control, between 20.8% O_2 to 100% O_2.

C. Set the Resuscitation Module **Airway Pressure Relief** to maximum and the **Flow Rate (LPM)** to 5. Connect the Oxygen Analyzer to the **Patient Outlet**. Calibrate analyzer at 100% O_2. Verify Blender accuracy at the following settings:

a. 100 % ± 4
b. 60 % ± 4
c. 40 % ± 4
d. 21 % ± 4

AIRWAY PRESSURE GAUGE (Non-AutoBreath)

A. Connect **Patient Outlet** to the **Airway Pressure Gauge** input using the 15-inch plastic hose and the 15 mm adapter. Adjust the Airway Pressure Relief to Maximum and the Flow Rate (LPM) to 5. The **Airway Pressure Gauge** should read 50 cm H_2O ± 8 cm H_2O.

SUCTION

A. Verify that the **Suction** Gauge reads -150 mmHg ± 15 mmHg when the Suction Control is set to maximum and the suction output is occluded. The suction output may be occluded at the Suction Jar located in the front of the Bassinet.

SUPPLY SWITCH

A. Verify that the Suction Switch turns the suction completely *Off* and completely *On.*